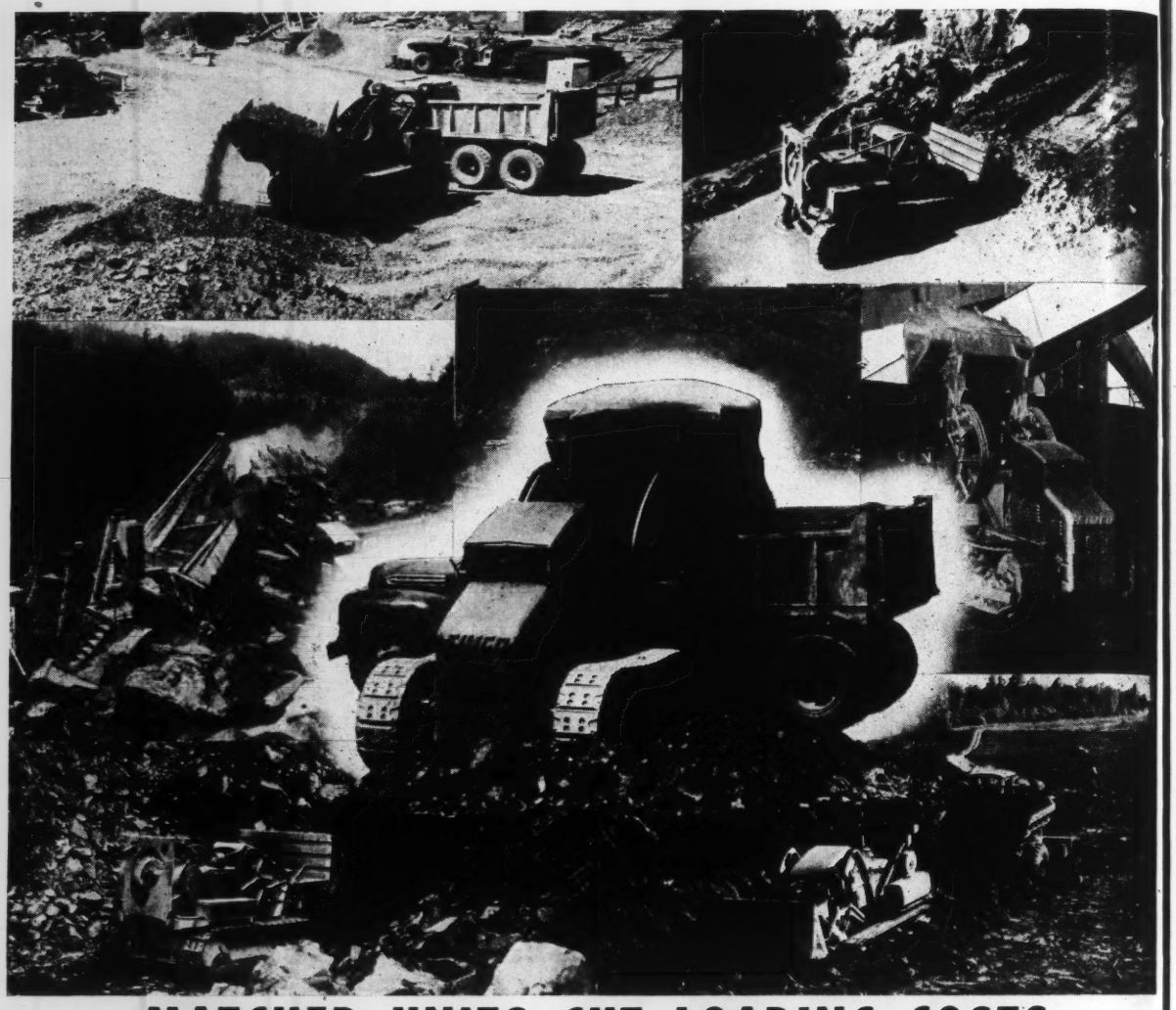
CIVIL ENGINEERING



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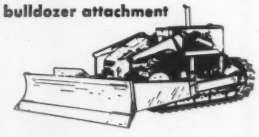
Eimco 105

Eimco 105 with bulldozer attachment



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FEBRUARY 1955
VOL. 25 • NO. 2

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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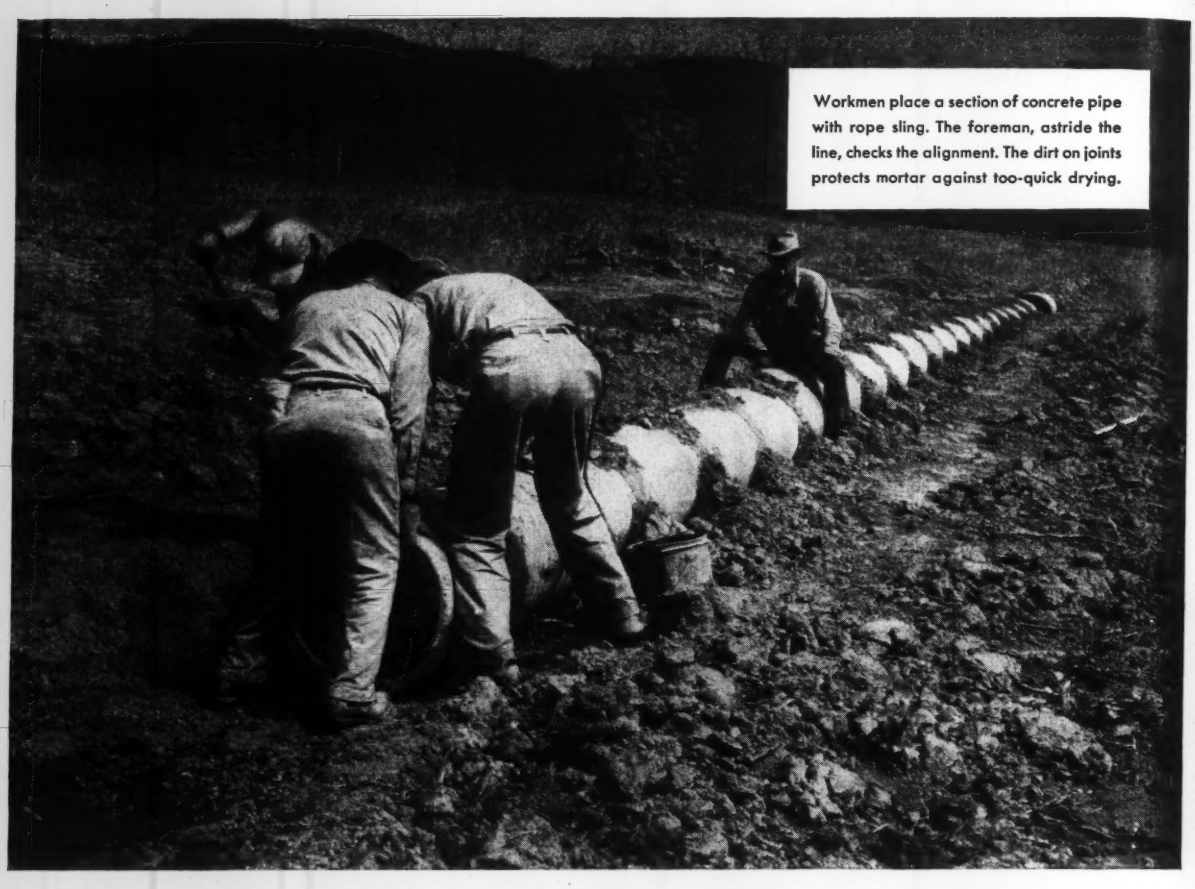

Workmen place a section of concrete pipe with rope sling. The foreman, astride the line, checks the alignment. The dirt on joints protects mortar against too-quick drying.

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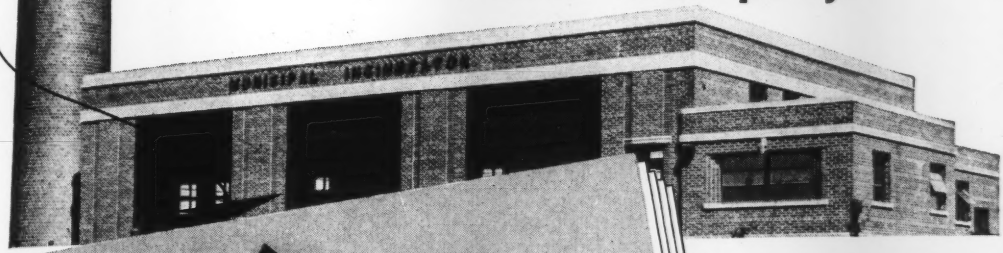

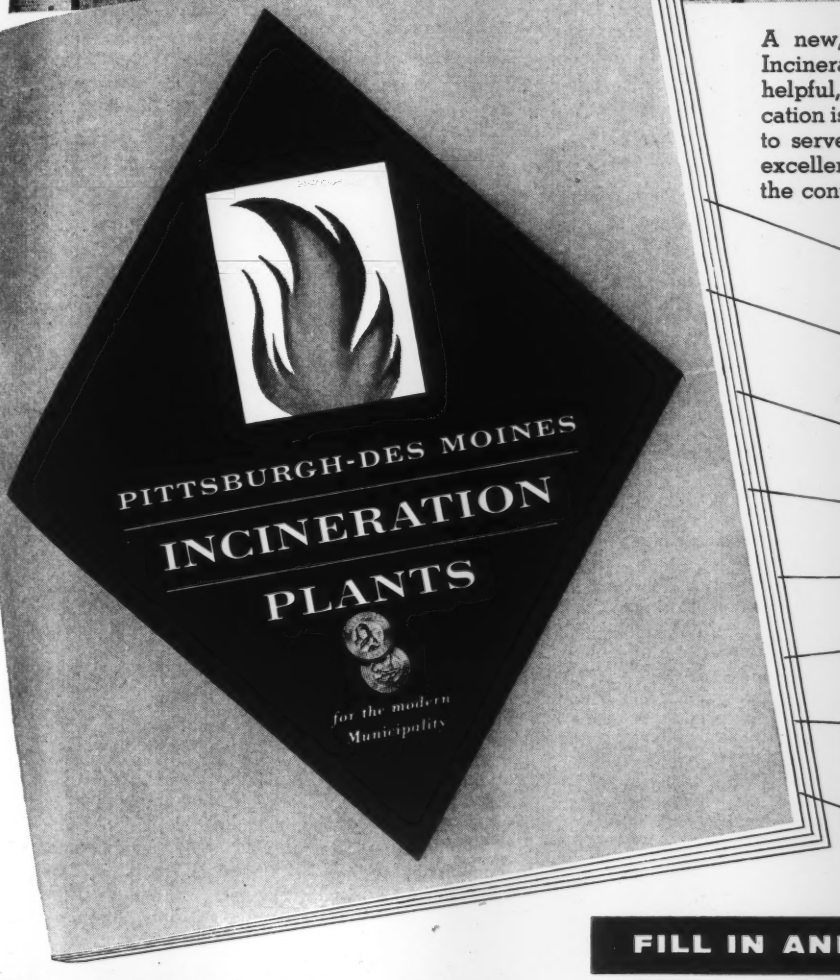

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NEWS OF ENGINEERS

William R. McGrath took office on January 1 as city traffic chief of New Haven, Conn., in charge of the new Department of Traffic and Parking. Mr. McGrath is a 1950 graduate of Rensselaer Polytechnic Institute and has worked as research assistant with the Yale Bureau of Highway Traffic. More recently he has been with Wilbur Smith & Associates which he joined in 1953.

John P. H. Perry has been elected president and director of the Lift Slab Corporation of New York City. Mr. Perry, a former vice-president and director of the Turner Construction Co., has recently been Deputy for Installations to the Assistant Secretary of the Air Force in Washington. He is a former Director of ASCE.

Nicholas R. Petry, senior partner and president of the N. G. Petry Construction Company, Denver, Colo., is the new president of the Associated Building Contractors of Colorado, Inc.

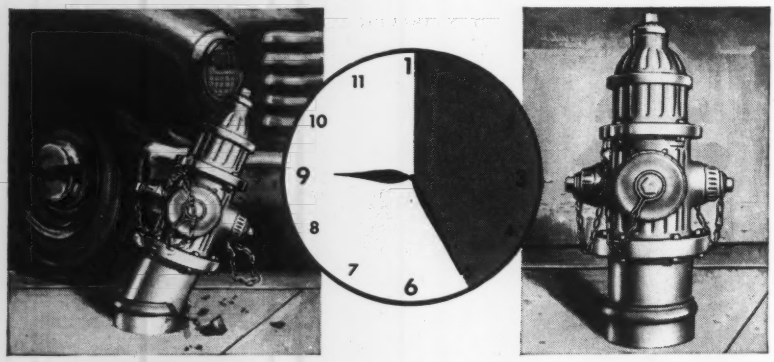
Gerald S. Rinehart and **Max Winter, Jr.,** who have been working on the new Cochabamba-Santa Cruz highway in Bolivia, received Bolivia's Order of the Condor at the dedication of the highway. Mr. Rinehart is associated with Knappen, Tippetts, Abbett & McCarthy as project engineer and Mr. Winter is project manager for Macco Panpacific Co., the contractors for the project.

Keith R. Barney, Colonel, Corps of Engineers, has been made director of installations, Office of the Deputy Chief of Staff for Logistics, Washington, D.C. Colonel Barney has been district engineer for the Corps of Engineers at Kansas City, Mo.

Harold M. Hultquist has been appointed field engineer for the Concrete Pipe Association of Michigan, Inc., Livonia, Mich. A 1949 graduate of the University of Michigan, Mr. Hultquist has been superintendent of public works for Livonia.

John R. Kiely, who is vice-president of the Bechtel Corporation of San Francisco, has been elected a director of the company.

Allen F. Clark, Jr., since 1952 district engineer for the Corps of Engineers at Memphis, Tenn., will become district engineer at Philadelphia. Colonel Clark, a graduate of the United States Military Academy and Princeton University, was commissioned in the Corps in 1932.



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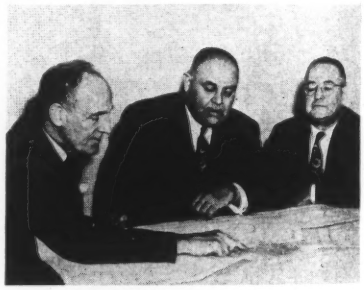

John J. Manning (right), M. ASCE, Vice-Admiral, CEC, U.S. Navy (retired), and former chief of the Bureau of Yards and Docks, has been appointed first full-time managing director of the Concrete Industry Board of New York City. Chatting with him are Wallace K. Harrison (left), M. ASCE, of the architectural firm of Harrison & Abramovitz, who has become a member of the board of directors of the CIB, representing the American Institute of Architects, and Roger H. Corbetta, president of the Corbetta Construction Co., Inc., and chairman of the CIB board of directors.

Charles C. Whittelsey, formerly vice-president in charge of construction for Ford, Bacon & Davis, Inc., New York City, is now executive vice-president. He will continue to be executive vice-president of the firm's subsidiary, Ford, Bacon & Davis Construction Corp. at Monroe, La. Mr. Whittelsey joined the firm in 1926 to work on construction of the Interstate Natural Gas Company's line from Monroe to New Orleans.

S. S. Steinberg, dean of the college of engineering at the University of Maryland, is one of eight educators, diplomats and scientists to receive a Certificate of Merit for his work in inter-American relations from the University of Florida. Dean Steinberg was recently on a trip in the South American and Caribbean area where he studied technical education and engineering for the Foreign Operations Administration (June issue, page 29).

S. Boyd Downey assumed new duties as chief engineer with A. J. Sockett and Sons Co., Baltimore, Md., on January 1. The firm specializes in the manufacture of equipment for fertilizer plants and furnishes complete designs for the plants. For the past twenty-one years Mr. Downey has been with the Pennsylvania Water & Power Co., Baltimore, which is merging with the Pennsylvania Power & Light Co.

Robert F. Edgar, who has been professor and head of the civil engineering department of the University of Pittsburgh, has been made assistant dean.

William P. Feeley, president of the Great Lakes Dredge & Dock Co., Chicago, Ill., has retired. Mr. Feeley joined the firm in 1907 after his graduation from the University of Notre Dame.

Richard Lankaster Hearn, of Toronto, is one of two Canadian engineers to receive the Julian C. Smith Medal awarded "for achievement in the development of Canada" by the Engineering Institute of Canada. Mr. Hearn joined the Hydro-Electric Power Commission of Ontario in 1942 becoming general manager and chief engineer in 1947. A graduate of the University of Toronto, he has long been connected with various Canadian power and construction companies, notably the Dominion Construction Company and H. F. McLean, Ltd. During the war Mr. Hearn served the Combined Production and Resources Board in Washington as Canadian technical adviser to the public utilities division.

John W. Robison is now working under the Technical Cooperation Mission on a large irrigation program in India, which has for its objective the completion of 3,000 driven wells by March 1956. His headquarters are in New Delhi.

(*Continued on page 24*)

JOB AFTER JOB, FRANKI FOUNDATIONS
SAVE TIME, TROUBLE and MONEY!

McWilliams Forge Co.
saved
$10,000!

Excavation for the poured concrete foundation of a 12,000 pound steam forging-hammer was almost complete when sand and water boiled up and collapsed the shoring around the hole, stopping the job. To get back on schedule, McWilliams called on Franki Foundation for a fast, *dependable* answer to their problem.

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Opening straight upward, Kinnear Rolling Doors coil compactly *out of the way* above the doorway. Materials placed within inches of the face of the door curtain won't hinder its smooth, easy operation. Surrounding floor and wall space is fully usable at all times.

Kinnear Rolling Doors are built to fit openings of any size. Kinnear Motor Operators add the convenience of push-button control, with remote-control switches at any number of points, if desired.

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News of Engineers

(*Continued from page 23*)

Henry L. Conger, chief engineer of Porter, Urquhart & Bevan, consulting engineers, Newark, N.J., will become chief engineer of Skidmore, Owings & Merrill for work on the Colorado Springs Air Force Academy. Mr. Conger and **Edward A. Merrill** worked on Moroccan airbases in which the two firms, Porter, Urquhart & Bevan and Skidmore, Owings & Merrill, under the name PUSOM, were concerned. Mr. Merrill has been made project manager (December issue, page 24) and Mr. Conger will work under him.

Clarence H. Ax, engineer for the Vollmar Brothers Construction Co., of St. Louis, Mo., has been elected vice-president in charge of building construction. Mr. Ax, recently elected president of the St. Louis Section of ASCE (see January issue, page 74), has been active in the construction industry in the St. Louis area since his graduation from Washington University in 1930.

Richard Dess, senior civil engineer for the City of Wauwatosa, Wis., is now acting city engineer for Wauwatosa. He will succeed **Henry Wildschut** who has become the county's first expressway engineer (November issue, page 23).

Harrison M. Tice, who has been assistant project engineer for the Bureau of Reclamation on various projects in Montana, has accepted a similar job with Uhl, Hall and Rich on the St. Lawrence Seaway Power project.

Franklin E. Lowance has been appointed director of research and engineering for the Westinghouse Air Brake Company, Pittsburgh, where he will direct the company's program and coordinate the research and engineering activities of all its subsidiaries and divisions. Since receiving his Ph.D. degree from Duke University in 1935, Dr. Lowance has served as head of the department of physics and engineering at Centenary College in Louisiana and as professor of engineering and physics at the Georgia Institute of Technology. During the war he served as a civilian in the Office of Scientific Research and Development, and, more recently has been technical director of the Construction Battalion Center at the U.S. Naval Civilian Engineering Research & Evaluation Laboratory at Port Hueneme, Calif.

Dr. F. E. Lowance

Speakers at the Third Annual Quality Concrete Conference, held at North Carolina State College in December, include (left to right) R. E. Fadum, M. ASCE, head of the civil engineering department at the host college; W. E. Dickinson, J.M. ASCE, field engineer for the Calcium Chloride Institute, Washington; Hubert Woods, director of research for the Portland Cement Association, Chicago; and J. H. Lampe, dean of engineering at North Carolina State. The two-day program covered a wide range of research and practice. More than 100 engineers and others attended the conference, conducted by the School of Engineering with the American Concrete Institute, the Portland Cement Association, and local groups as sponsors.

John W. Johnson, of Buffalo, has been appointed by Governor Harriman to the cabinet post of Superintendent of Public Works for New York State, and took office on January 1. Mr. Johnson has been vice-president and general manager of the Brunner Asphalt & Construction Co. since 1953 and is president of the New York State Sewage and Industrial Wastes Association. Earlier he was general manager of the Buffalo Sewer Authority.

Clyde N. Baker, Jr., former research assistant at the Massachusetts Institute of Technology Soil Stabilization Laboratory, is now employed by Soil Testing Services, Inc., of Chicago, Ill. Mr. Baker recently left Switzerland where he had been on a summer fellowship at the Swiss Federal Technical Institute in Zurich.

Walter Edmund Hanson has resigned his position as engineer of bridges and traffic structures for the Illinois Division of Highways. Mr. Hanson, together with **Roland D. Collins** and **Marcus J. Rice,** former bridge designers of the Highway Department, has formed a consulting firm in the field of bridges, structures and foundations. The firm, to be known as W. E. Hanson & Associates, will be located at 401 East Capital, Springfield, Ill.

(*Continued on page 26*)

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When you need large capacity lines to handle air or water on construction jobs, you'll find your best bet is Naylor lightweight pipe. Top performance in either service is built into this distinctive pipe through features not combined in any other light weight pipe.

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FR-216	Easy Excavating in a Tough Pit	FR-102	Digging Gravel From a River
FR-213	Cleaning Ponds Without Draining	Catalog C	Sauerman Slackline Cableways

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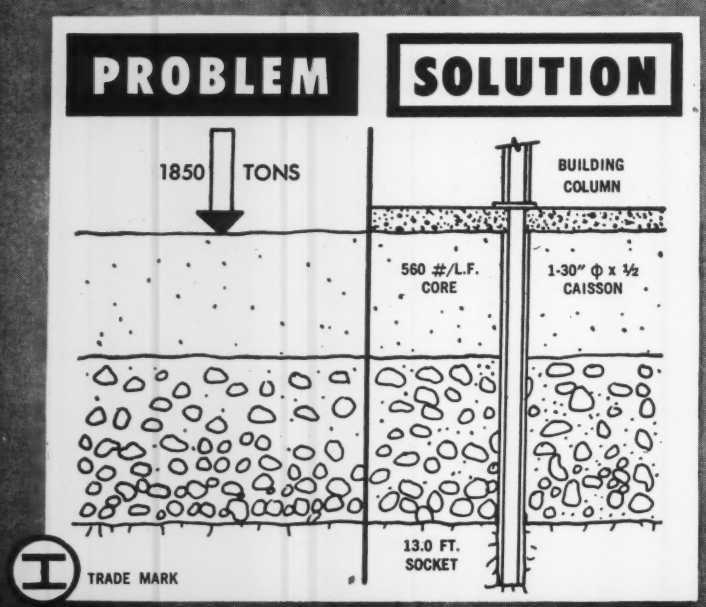

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News of Engineers

(*Continued from page 25*)

Ray E. Bollen has been appointed a staff engineer of the Highway Research Board in Washington, D.C. He will be engineer of materials, construction, and maintenance, the position formerly held by **Elmer M. Ward,** now assistant director of the Highway Research Board (December issue, page 24). Mr. Bollen served with the Nebraska Department of Roads and Irrigation from 1930 to 1942 as assistant testing engineer and from 1942 until the present as testing engineer.

Jack Singleton, recently retired chief engineer of the American Institute of Steel Construction, has opened a consulting office at 4815 Dodge St., Omaha, Nebr. Mr. Singleton joined the Institute in 1928 as district engineer at Topeka, Kans. Previously he had been chief engineer and general manager of a steel fabricating firm and a consulting engineer. Mr. Singleton is widely known for his authorship of technical manuals and as a speaker on engineering subjects.

Jack Singleton

John R. Hoffert, chief engineer of the Pennsylvania Health Department, Harrisburg, Pa., has announced his retirement. He has worked for the department since 1919 and was appointed to his present position in 1948. Mr. Hoffert, a graduate of Cornell University, has been secretary of the Sanitary Water Board and helped launch the Board's Clean Streams Program.

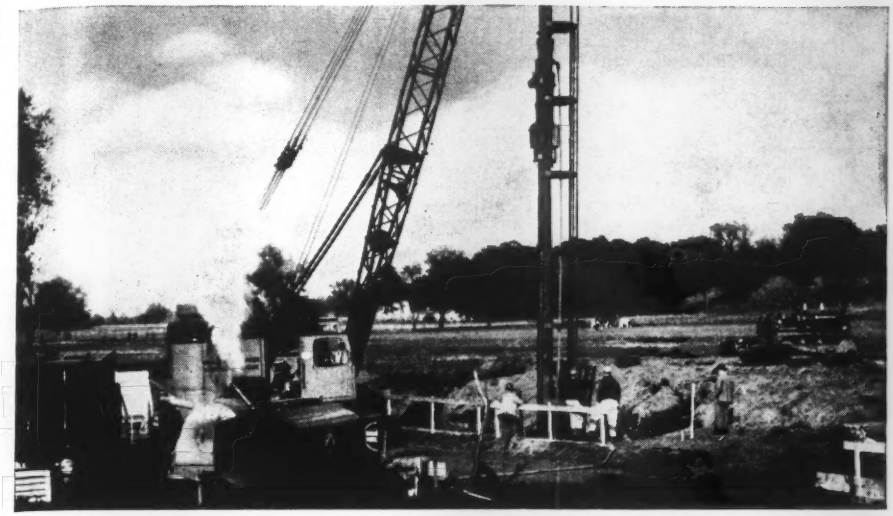
Jack F. Daily recently was made a partner in the consulting engineering firm of Lutz & May Company, Kansas City, Mo. Mr. Daily has been head of the civil engineering department at Lutz & May for the past six and a half years.

Homer T. Borton, treasurer and chief structural engineer of Osborn Engineering Co., Cleveland, has been elected president of the Cleveland Society of Professional Engineers.

L. Sterling Hedgpeth, highway engineer with the U.S. Bureau of Public Roads, has been appointed chief of the specifications and materials section in the Construction Branch of the Public Roads, Washington, D.C., office. Mr. Hedgpeth was recently in Turkey where he has been for six years a member of the Public Roads advisory group of the Aid-to-Turkey Mission.

(*Continued on page 28*)

INDIANA TOLL ROAD | Uses Armco Foundation Pipe



Driving Armco Foundation Piling for the Indiana Toll Road. This installation is a bridge project over the Sycamore Road, 10 miles northwest of South Bend, Indiana.

Rieth-Riley Construction Company, Inc.—General Contractors
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One of the newest expressways in the country is the Indiana East-West Toll Road, now under construction across northern Indiana.

In Sections C-24 and C-25, Armco Foundation Piling is being driven for a bridge foundation. This piling is 14" O.D., in .188" wall, with a design capacity of 30 tons. Many of these piles were actually driven over 60 tons capacity without difficulty. This is just one of six grade separations in these sections.

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	ARMCO CAISSONS	24" to 36"	.375" to .500"	Up to 70 feet
	ARMCO HEL-COR PILE SHELLS	8⅝" to 22⅛"	18 to 14 Gage	Up to 60 feet

For specific data on your foundation problems, write us. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 3955 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Workman welding cone points to the Armco Foundation Piling used on this project.

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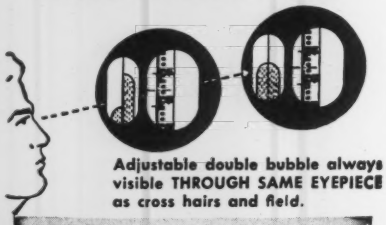
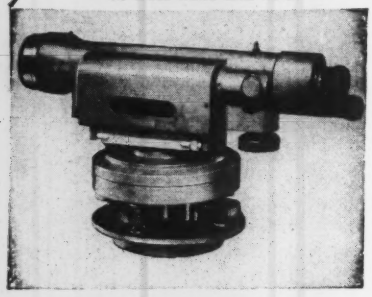


Adjustable double bubble always visible THROUGH SAME EYEPIECE as cross hairs and field.



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News of Engineers

(*Continued from page 26*)

Samuel B. Lincoln and **William J. Heiser** have been elected to new positions in Lockwood Greene Engineers, Inc., of New York City. Mr. Lincoln, who joined the company in 1908, has been elected chairman of the board. Formerly he was president and treasurer of the company. Mr. Heiser, with the company since 1926, will be new president and treasurer. He previously served as executive vice-president and chief engineer.

Angell Dominice Sidio, of Cheyenne, Wyo., is moving to Pueblo, Colo., to become sanitation director there. He has been engineer in charge of the Water Pollution Control Section of the Wyoming Public Health Department.

John Bertram Stirling, president of E. G. M. Cape and Company, Montreal, has been awarded the Sir John Kennedy Medal by the Engineering Institute of Canada. The medal is given for unusual services in the development of Canada and for forwarding the engineering profession. Dr. Stirling joined the staff of E. G. M. Cape and Company in 1915 and, in 1928, became a partner in the firm. He has been active in the Engineering Institute of Canada, which he joined in 1913. Since 1939 he has served on the executive committee of the Montreal Branch, and was chairman of the Branch in 1945. He was councillor of the Institute in 1946, vice-president in 1951, and president in 1952.

L. B. Combs, Rear Adm. (ret.), head, of the civil engineering department of Rensselaer Polytechnic Institute, has been made an Honorary Life Member of the National Security Industrial Association.

John Henry Schipke, Jr., is opening a consulting engineering firm in Minneapolis, Minn. The firm will deal with investigation of structural problems, evaluations, design, specifications, cost estimates and field inspection of contract work. Mr. Schipke was formerly senior engineer and structural engineer for General Mills, Inc. in South Minneapolis.

Kanwal S. Bawa, soils and foundations engineer for Kornacker & Associates, Inc., Consulting Engineers of Chicago, is touring the United Kingdom, India, Thailand, and Japan.

Bernard L. Werner, deputy water engineer with the Bureau of Water Supply, Baltimore, Md., has been appointed water engineer.

Clinton N. Hernandez, a vice-president of the Turner Construction Co., New York City, will be in charge of the new regional office of H. Zinder & Associates (Washington, D.C.) at Portland, Oreg.

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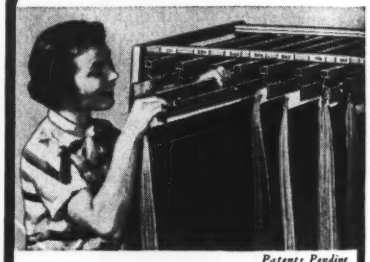

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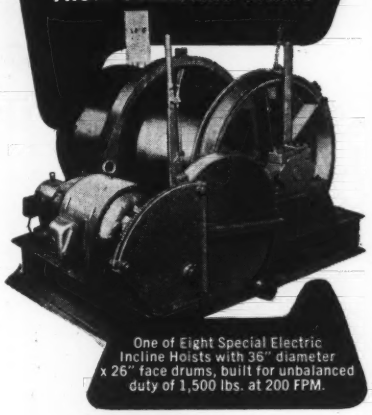

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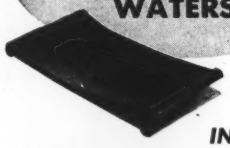

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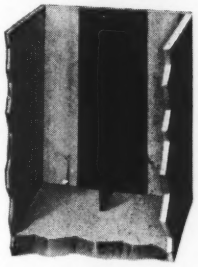

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RECENT BOOKS

Manual of British Water Supply Practice

Separate groups of experts have collaborated to produce this authoritative survey of water supply practice, based mainly on British experience but with appropriate reference to work in other countries. The book, edited by Aubrey Thomas Hobbs, covers the entire field from hydrology and hydrogeology to financial, legal, and management problems. Reservoirs, aqueducts, wells, pumping plants, and so on are dealt with, as well as all phases of water treatment and examination. The complete text has been revised in the light of new developments, and a chapter on economic aspects of water engineering has been added. Chapter bibliographies are included. (Published for The Institution of Water Engineers by W. Heffer & Sons Ltd., Cambridge, England, second edition, 1954. 963 pp., 55s.)

Soil Mechanics Related to Building

A brief introduction for students and for engineers without previous study of the subject. The aim of the book by—John H. G. King and Derek A. Creswell—is to present established principles useful for the design and supervision of foundations, excavations, and earth-retaining structures where the cost of a professional soil mechanics survey is not justified. The material included covers site investigation, laboratory tests, soil classification, stability of cuttings, etc., and choice and depth of foundations. Short lists of references for further reading are provided. (Sir Isaac Pitman & Sons, Ltd., London, 1954. 168 pp., 16s.)

Strength of Materials

This edition of a textbook by Joseph Marin and John A. Sauer for a beginning course contains new chapters on creep and temperature properties of materials, and experimental methods of stress analysis. There are also new sections on vibrations of beams, stress concentration, and beam columns, and numerous changes have been made to bring the material up to date, especially in chapters dealing with fatigue and impact properties, and theories of failure. (Macmillan Company, 60 Fifth Avenue, New York 11, N.Y., second edition, 1954. 518 pp., $6.75.)

A Treatise on Applied Hydraulics

The present edition of this work by Herbert Addison which originally appeared in 1934, limits itself, like its predecessors, to direct explanations of hydraulic principles and provides bibliographies of selected references for those needing more detailed information. Fundamentals are treated in the first section of the book and applications in pipes and piping systems, hydraulic turbines, pumping machinery, etc., in the second section. The new edition has been thoroughly revised, with the addition of about a hundred pages of text. (John Wiley & Sons Inc., 440 Fourth Avenue, New York 16, N.Y., fourth edition, 1954. 724 pp., $9.50.)

Sportbauten

A comprehensive and detailed treatment by Rudolf Ortner of the layout, construction, and equipment of sports structures, including the grounds, tracks, and playing fields. All sports, both indoor and outdoor, are covered, with details such as drainage and sprinkler systems, track foundations, seating arrangements, etc. There are many line drawings and photographs, and a five-language glossary is appended. (Verlag Georg D. W. Callwey, München, 1953. 312 pp., DM 48.00.)

TIDE GATES

Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

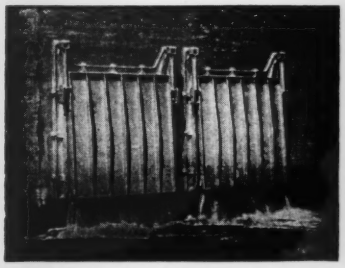

Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

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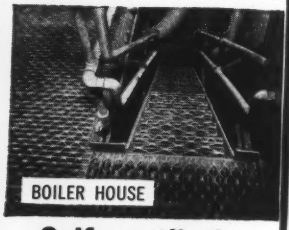

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do you know that

Construction activity set a new record in 1954? Predictions of a new construction record for 1954 have now been confirmed by Department of Commerce and Labor reports, which estimate new construction put in place last year at $37.2 billion—5 percent above the 1953 figure (page 80).

This year ushers in a new era of transportation? The *USS Nautilus*, launched in Long Island Sound on January 17, is the first conveyance in history to be moved by atomic power.

The Clay Committee Report supports the toll method of financing the Interstate Highway Net? The report is abstracted on page 48. Current thinking on the availability of men, money, equipment and materials is reflected in reports in this issue.

EJC is sponsoring important new activities? Engineers Joint Council has just been host to a highly successful General Assembly, which gave attention to professional affairs in terms of today's living (page 68). In the works is a week-long Nuclear Congress, to be held in Cleveland in December (January issue, page 66).

ASME is celebrating its seventy-fifth birthday? On February 16 the American Society of Mechanical Engineers begins the first of a year-long series of ceremonies to mark its founding on February 16, 1880. Its anniversary theme is "By truth and by service to enrich mankind."

Two huge generators have gone into service for the AEC? In January two 200,000-kw turbo-generators of the Ohio Valley Electric Corporation began feeding power to the AEC's uranium diffusion plant near Portsmouth, Ohio (August issue, page 44). This energy is the first to be supplied from Clifty Creek and Kyger Creek steam power plants, which will have an ultimate capacity of 2,200,000 kw (all for the AEC) and represent a private utility investment of $400,000,000.

The long-argued Narrows Bridge may be started this year? Key feature in a $379,000,000 program of bridge and arterial highway construction—recommended for the city by the Port of New York Authority and the Triborough Bridge and Tunnel Authority—is a suspension bridge across the Narrows. With a 4,400-ft-long clear center span, the bridge would be the longest in the world.

Cloud seeding for snow is being tried? Cloud-seeding experiments are being tried by the Pacific Gas and Electric Company in three sections of the Sierra Nevada in an effort to increase the winter snowpack for additional runoff for hydroelectric plants. Ground-based silver iodide crystal generators are being used in the experiment.

A Cross-Cuba Canal is being planned? Construction of a $400,000,000 north-south canal across Cuba will be undertaken by a company of Cuban businessmen. Built as a two-way waterway and deeper than New York Harbor, the proposed canal would cut some 400 miles off the journey between northern ports and the Panama Canal and South America.

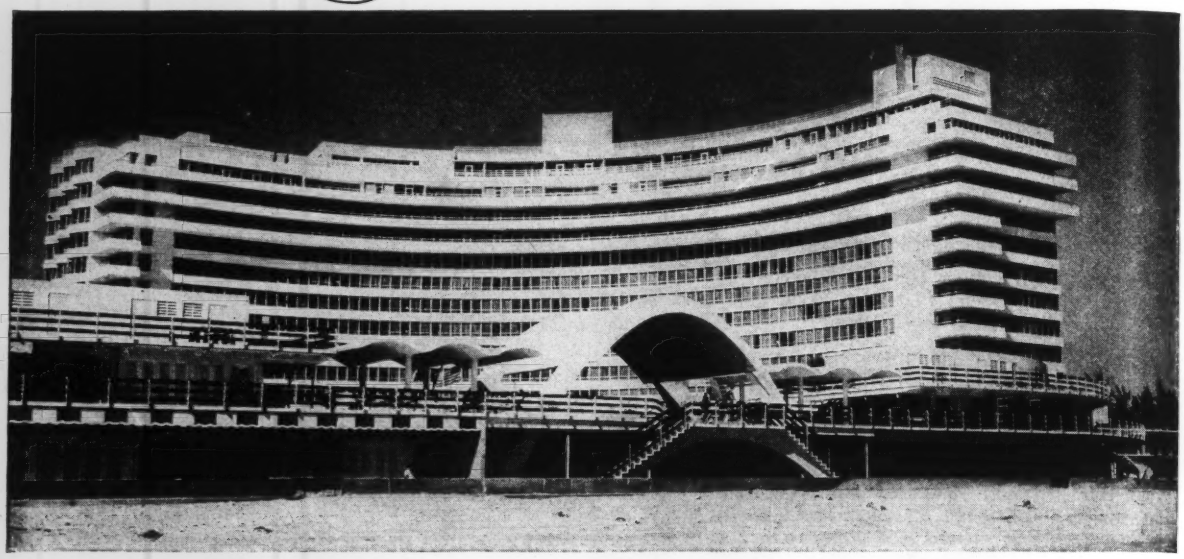
There is an index for Proceedings-Separates? To aid you in finding what subjects have been written about in the 581 Proceedings-Separates issued since February 1950, an author and subject index is now available. The index (identified as Proceedings-Separate 582) will be sent to you as one of your 100 free separates upon receipt of the coupon on page 124.

Urban heliports are on the way? So say two research engineers, who discuss heliport planning and construction in this issue. Use of the helicopter in mapping remote areas was described in the December issue.

The AIChE has a new secretary? Franklin J. Van Antwerpen has been installed as executive secretary of the American Institute of Chemical Engineers.

Tecolote Tunnel, holed through on January 15, was one of the wettest and hottest jobs on record? Watch for an article next month on how water, gas, soft ground, and heat were overcome on this Bureau of Reclamation project, which will deliver 100 cfs of needed water from Cachuma Lake, Calif., to Santa Barbara.

the fabulous **Fontainebleau**



Miami Beach's Magnificent New Hotel, Luxurious Place in the Sun, Concreted with 'Incor' for Economical Speed

Ground broken January 10, 1954 . . . highly complicated structure completed, hotel furnished, staffed and operating December 20, 1954 . . . Contractor says on-time completion would have been impossible without 'Incor' 24-Hour Cement.

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General Contractor:
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Ready-Mix 'Incor' Concrete:
MAULE INDUSTRIES, INC., Miami Beach

● Magnificent new $14-million Fontainebleau Hotel, on the old Firestone ocean-front estate, 44th to 48th Streets, Miami Beach, opened its hospitable doors precisely on schedule last December.

Called with good reason America's largest and finest resort hotel, The Fontainebleau reflects in its every line and appointment a happy balance of hotel, architectural and construction imagination.

With concaved façade fronting on 950 ft. of private beach, the new 14-story hotel, air-conditioned throughout, has 565 bedrooms and suites, 263 cabanas, and private yacht anchorage.

'Incor' Speeds Completion

Construction is concrete throughout, for utmost stability and fire safety. On the basis of wide and successful experience, Taylor Construction Co., General Contractor, used 'INCOR' 24-HOUR CEMENT, 23,332 bbls., for dependable high early strength so essential in maintaining precise concreting schedules required for top construction speed at rock-bottom concreting cost.

Clock-like, pour-today-strip-tomorrow schedules saved $37,000. in extra forms that would have been needed for equal speed without 'Incor'. And the Contractor says this figure was dwarfed by time and labor economies due to smooth-running, assembly-line concreting schedules.

Match high-early strength economies with high ultimate strength and long-time durability and you see why 'Incor'* "belongs" on outstanding projects such as this.

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EARTH MOVING . . .

Each project a new problem

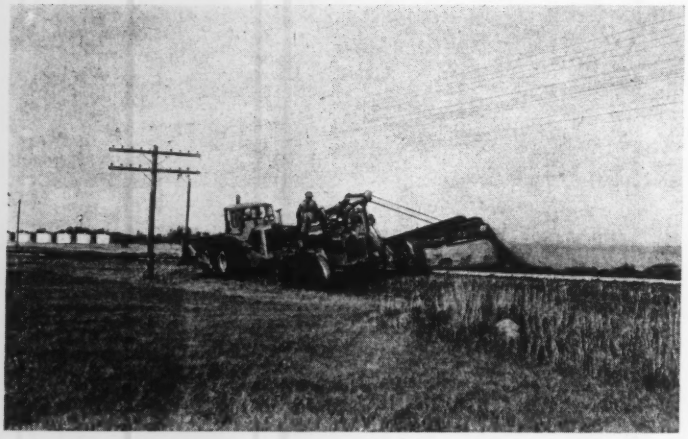
D. K. HEIPLE, Chief Field Engineer, LeTourneau-Westinghouse Company, Peoria, Ill.

An engineer and contractor choosing equipment for a given piece of work is likely to find himself in the predicament of trying to solve a single equation involving a number of unknowns. Although there may be one best answer, several other answers are also attractive because of considerations outside the job in hand. Although the design of structures using earth as a construction material may, in most respects, have reached the status of a science, the actual accomplishment of the work is still more of a highly developed art than a truly predictable production-line science that can be reduced to dependable treatment by formula. The manufacturer who makes the tools of construction can pinpoint his efficiencies and costs because he repeats the same operations time after time, whereas the customer for his equipment can never expect two identical jobs, so any cost experience he develops is indicative rather than conclusive. Now that we have firmly established an unstable base for this discussion, I would like to present some of the variables, with a few of the equipment possibilities or probabilities.

In earth-moving construction, there are essentially three operations to be performed, sometimes four: (1) excavation; (2) hauling; (3) placing; (4) processing, in the cycle between (1) and (3), occasionally.

To limit the material covered in this article, those jobs which obviously fall in a specialized category are excluded. Operations involving materials lying under water, requiring dredge, dragline, or slack-line scrapers are not considered neither are hard-rock formations that can be handled only by drilling and shooting prior to shovel loading. Types and capacities of equipment are compared only in the range where they overlap and can be applied to the same work, although at different production and cost rates.

Bulldozer, workhorse of the construction industry, has more uses than a hundred-bladed pocket knife. Short-haul raising of road grade from ditch borrow is typical dozer work.



Sidecasting of earth with an elevating grader is one of the cheapest types of earth moving. However, application of this equipment for maximum efficiency is limited to long, level stretches of windrowed earth.

Shovels and hauling units are most effective when excavating a high face. With excess trucks available, top shovel efficiency is gained by loading on two sides. Dozer cleans spillage while shovel loads hauling unit on opposite side.

A tremendous amount of earth, sand, gravel, metallic and non-metallic ores and minerals can be handled by a wide variety and size of equipment, the selection of which is a problem in profit economics.

Bulldozers are basic

Bulldozers come first. Of all the tools available to the contractor or industry, the bulldozer is basic. Its versatility is almost unlimited. A 100-bladed pocket knife can hardly accomplish the same number of tasks that can be profitably handled by the tractor or bulldozer. The economies of the dozer, however, are due to its ability to do work difficult or impossible to accomplish with other machinery, or where the quantity is insufficient to justify moving it by more highly specialized and productive equipment. There is little doubt that in high-production earth moving, the shovel and dragline, elevating grader, and carrying scraper can all produce at a cheaper cost per yard than the bulldozer. The use of the bulldozer, then, is not based on type of material or distance moved, but on restricting conditions of excavation and placement, or perhaps relatively small volumes.

Consider the problem of backfilling a trench where the material has already been excavated and is lying in a long windrow to one side. Discharging a load into a trench is difficult if not impossible for scraper equipment, which would not be used unless the amount of work was negligible and other equipment not readily available. Without much face to work against, a shovel would not load from the windrow efficiently, and with both a shovel and a dragline there would be a lot of lost motion in cleaning the area, although again both might be used. The bulldozer, on the other hand, is immediately recognized as highly efficient, since it merely shuttles back and forth pushing the dirt ahead of it into the trench. Because of this and other rather obvious examples, the tractor dozer has acquired somewhat of a reputation as the most economical short-haul tool. However, by changing excavation and placement requirements while retaining the short haul, it can be demonstrated that the length of the haul has very little to do with it.

Take the problem of constructing a road from ditch borrow where the actual distance the dirt is to be moved is, as in the backfilling of a trench, a matter of only a few feet. The bulldozer is, of course, an effective tool. Nevertheless, unless the sections are so short that a great deal of time is lost in turning, an elevating grader can side cast at a rate of from 3 to 5 times dozing production and is unquestionably one of the cheapest methods of earth moving. The bull-

(Vol. p. 68)

dozer might still be employed to spread the windrow laid down by the elevating grader, but here again, unless the windrow is extremely heavy, another earth-moving tool (the motor patrol) will do a better, cheaper job.

It is not quite so easy to visualize a comparison of the dozer as a short-haul tool with the scraper, but for all practical purposes the comparison is just as valid. Take a similar road construction job using ditch borrow, which is to be moved about 50 ft. A bulldozer making a complete pass every three-quarters of a minute and carrying $3^1/_2$ pay yards on the blade would put 233 cu yd in place per hour. The same tractor pulling a scraper would load parallel to the road, turn on to it and spread in the opposite direction, traveling in all approximately 300 ft. Making such a cycle in 2 min and carrying 12 cu yd in the scraper, this combination would produce 300 cu yd per hour. If the cost per hour of a tractor with bulldozer is $10, the tractor-scraper can cost $12.80 per hour and still give the same cost per cubic yard. The apparent conclusion is that, at any distance, the scraper moves dirt as cheap as or cheaper than the bulldozer, if conditions of digging and spreading will allow its use.

There are many good, economically sound reasons for selecting the bulldozer for a given job. The above examples merely demonstrate that shortness of haul is not in itself the important factor. The bulldozer can and will be used on short-haul work simply because its efficiency is good enough, and alternate means are not readily at hand. At the same time the dozer can hardly be considered a long-haul tool. The normal limits within which other factors seem to justify its use are approximately 300 to 400 ft. Beyond this point, the reduction in yardage handled, and consequent increase in costs, usually more than offset the ability to excavate or place material more efficiently than other equipment items. For instance, using the production-rate figures prepared by a manufacturer of both crawler tractors and scrapers, the highest estimated production for dozing at 200 ft is about 175 cu yd per 60-min hour, whereas a tractor with a 12-cu yd scraper can produce the same amount at 400 ft.

In the final analysis, the bulldozer is so widely used because it is a very effective tool in two of the three main operations of earthmoving—excavation and placement—as well as in a multitude of special assignments. Estimating its rate of production, however, is often a difficult task. On straight short-haul work, the dozer's blade capacity, coupled with its speed of forward and reverse travel, can be calculated, but on extremely short hauls the ability of the machine can outstrip the willingness of the operator, so that its capability reaches a lower limit of cycle time at perhaps 0.5 to 0.75 of a minute over any extended working period.

Other types of work may require considerable analysis and even then may defy any attempts to secure real accuracy. For instance, clearing of wooded areas may require a tree count by sizes. For sizes under 6 in. in diameter, the bulldozer can probably take out trees and brush the width of its blade at a constant rate of travel. For diameters of 6 to 12 in., both the type of tree and the soil combine to give a spread in working time of 1 to 3 min per tree. Trees over 12 in. in diameter may require from 5 min up to 30 or 40 min for cutting the roots and building a ramp to gain sufficient leverage to take them out. Times fluctuate widely depending on local conditions. Some varieties of trees have tap roots, which in light soil may slow up the work. Conversely, big trees in loose soils with root systems close to the surface—or so rotted that you wonder what held them up—may go over with a single push. It is impossible to establish a reliable production chart, but it can be said that big tractors will clear 1 to $1^1/_2$ acres per hour.

Here again, as with earth moving, if a significant volume of work is involved, special attachments are probably the most economical. Teams of tractors, using root cutters and special tree pushing attachments, or pulling chains or cables between them, have proved very effective. Where such special tools are used, care should be taken to fell the timber so that a pile of jack straws does not result, and so that the trees can be pushed into piles for burning or other disposal by following bulldozers.

It all boils down to the fact that few, if any, construction jobs can operate efficiently without the bulldozer. The choice involved is between rubber tires and tracks, and a wide variety of sizes. It is probable that an equipment grouping of any size should include both tracked and tired bulldozers for maximum efficiency. The mobility of tires on a big job is invaluable both for speed and for ability to travel over paved surfaces—also where abrasive materials may cause excessive track wear. On the other hand, the superior tractive effort, per pound of tractor weight, inherent in the crawler cannot be denied where underfoot conditions are extremely bad, or where the last ounce of brute force is required.

For each pound of tractor weight the track-type machine will, under average conditions, produce about 0.85 lb of push or pull. The rubber-tired unit will produce about 0.65 lb of pull or push. Since the rubber-tired unit is as much as twice as fast, its speed may actually enable it to out-produce the track machine either on production work or by sheer mobility on odd jobs. The track-type unit, however, will work under conditions of grade impossible for tires, or in situations of lower flotation and traction.

After the bulldozer, a number of different types and sizes of equipment can, and are, every day applied competitively to the same kind of work. Making a selection for earth-moving production involves four major considerations—speed, capacity, maneuverability, and working efficiency. Each of these in turn is a function of a number of other factors, as follows:

A. Speed, which is a function of:
   1. Engine power and rpm*
   2. Final gear ratio*
   3. Gross weight, including load
   4. Roadway conditions
   5. Grades

B. Capacity, which although a fixed quantity, must be reduced to the basis of pay yards or bank measure, thus becoming a function of:
   1. Type of material
   2. Power available for loading*
   3. Loading grades

C. Maneuverability or relative ability to load, accelerate, spread and turn—which is a function of:
   1. Speed and power of loading equipment*
   2. Grades
   3. Power-to-weight ratio*
   4. Type of ejection*
   5. Speed and degree of steering device*

Those factors followed by an asterisk are inherent in the design of the equipment by make and, in some instances, by type. The other factors are variables that must be evaluated for each individual job before an intelligent selection of type or make can be made.

Generally speaking, the conditions here considered are applicable to a selection of the following types of equipment:

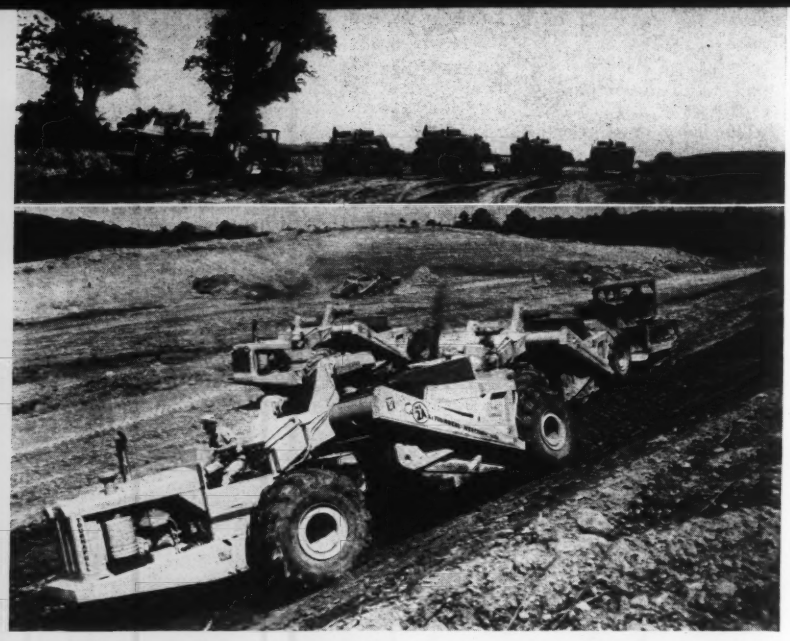
1. **Scrapers,** either rubber-tired prime movers or track-type, tractor-drawn, with the probable inclusion of additional tractors as push-loading units.

2. **Shovels and/or draglines,** loading wagons of rear-dump, bottom-dump or side-dump type.

3. **Elevating graders or loaders,** loading hauling units of the same types as in Item 2.

Special situations that might also include tramways, conveyor belts, or rail haulage are not considered to be a truly competitive choice.

Functions of speed involve differences in make to a much greater degree than in type, and as such will not be



Overall efficiency is lost when scrapers bunch up on pusher units. Proper ratio between items of equipment is one of major factors in cost control of project.

discussed separately. Capacity, although similarly classified, is a general problem worth discussing at least briefly. Within limits it is certainly true that greater capacities give greater economies. For any given job, of course, specific conditions may restrict the physical dimensions or the weight. It still takes one operator, whether for an 8-cu yd scraper or an 18-cu yd machine, and some of the other expense items are similarly fixed. Manufacturing costs, however, do currently impose some general upper limits. Engines, transmissions, clutches, tires, and other components either are not available or, because of limited production, are expensive. The alternatives of multiple engines and other components lead to complexities and expensive maintenance. Nevertheless, special situations do make really big equipment economical, and we, as well as other manufacturers, have a continuing interest in its development. At present, however, in mobile equipment the more reasonable limits of capacity are defined by 300- to 325-hp engines with other matching components in the 30- to 35-ton range.

Although it can be demonstrated that horsepower need not limit capacity for greater production, it does limit it from the standpoint of unit cost. Hauling bigger and bigger loads with the same horsepower has the simple result of utilizing the available horsepower more completely under all conditions, plus making the relatively fixed time items in a hauling cycle a smaller percentage of the total. The result—greater production.

Not so easy to demonstrate but equally true is the fact that costs do not seem to follow the same pattern. Generally speaking, plotting production in yards per hour against the power-to-weight ratio, in pounds per horsepower, should show production increasing as the weight per horsepower increases, as already mentioned. However, plotting cost per cubic yard against the same power-to-weight ratio presents a somewhat different picture. Such a procedure should show generally a curve which at both extremes (very high or very low power-to-weight ratios) gives the higher costs, with the lowest costs in the middle range. For example, hauling with 1,000 lb of loaded weight per horsepower, or with 100 lb per horsepower, is almost never economical with rubber-tired equipment. The best cost picture will most often be found in the range between 300 to 450 lb per hp.

Fourth consideration—working efficency

As for working efficiency, this is not the most important factor on which to base selection of equipment, but it is the item against which all the other factors must be measured. For instance, an elevating grader may be capable of loading hauling units at a rate of 1,000 cu yd per hour, but if turning time in a short cut area restricts the productive time to 50 percent, it is the 500-cu yd rate that must be compared with the rate and cost of alternate methods. In like manner, material requiring prior rooting for scraper loading may call for an analysis of shovel rates before final choice; a limited face of cut or frequent moves will seriously hamper continuous output by a shovel or dragline.

Actually, there are a number of different efficiencies involved. The following are some of the observations and findings of people not engaged in the manufacture of equipment.

At a meeting of approximately 300 engineers representing heavy equipment manufacturers several years ago, the equipment superintendent for one of the largest and most successful contracting firms in the United States declared that 75-percent productivity was the best that could be expected from construction machinery at that time, and the situation for all intents and purposes is still the same today. To the question as to whether this figure might possibly be made 80 percent, he replied simply that the poorhouses were full of contractors who thought it could. Assuming that this thinking is incorporated in the competitive bidding of the company, and judging from its success, his percentage is a difficult one to refute.

As manufacturers, LeTourneau-Westinghouse and many other companies have found a job operating efficiency, including minor delays in coordinating equipment and operators, and excluding mechanical difficulties and weather, of about 83 percent, a 17 percent loss of productive time. This is the 50-min working hour of production estimating. Added together, the 25-percent loss due to mechanical availability of equipment, and the 17-percent job loss (due to human efficiency) account for an appalling total time loss of 42 percent, immediately raising the question as to whether the two do not possibly overlap. Without positive evidence to the contrary, it is an assumption that a great many of us might like to make; and undoubtedly they do overlap to a large degree on the better laid out, managed, and serviced job.

Modern high-speed machinery, although capable of tremendous output, requires also the input of a high degree of coordinating skill. Big jobs, with different types of equipment working as a team, put particular emphasis on correct planning and follow-through. It is one thing to build a mile of county road from ditch borrow with two tractor-scrapers; it is another to shoot and shovel-load rock, haul it to a crusher, rehandle from crusher to hauling units, place, spread, and compact it for an airport runway subgrade.

Results of several years of investigation by the Highway Research Board of the National Research Council, published in 15 separate reports during 1949, would indicate that the problems of current construction make even 75-percent productive time easier to talk about than to realize. The detailed breakdown does not necessarily check with individual experience, but the total percentages can leave no doubt there is much room for improvement.

The percentage figures reported by the Highway Research Board have been adjusted to exclude delays due to weather, but include those due to all other causes. The adjusted results are repeated in Table I. Some of the items listed do not fall in the scope of this paper, but are included for general interest. No attempt was made by the Board to compare efficiencies of various types; it simply reported what was observed with little or no comment. No final comparison is intended from the discussion of these figures.

In view of the variables involved, the final conclusion, even if correctly drawn, would not be a true measure of machine performance. The machinery involved, where applicable to the same kind of work, is generally recognized as being currently competitive on a unit cost basis. Thus, a machine capable of competing within a reasonable cost range, and for which a low efficiency was reported, simply offers more room for improvement and could well prove the most economical tool under favorable job conditions if its possibilities were more fully realized.

Also, a single shift should ordinarily turn in a higher efficiency than two- or three-shift operation, and an eight-hour shift should be more efficient than one of ten hours. There is no notation as to whether or not all are reduced to the same basis. Similarly, it is impossible to tell whether a loader with a 37-percent individual efficiency does not keep sufficient hauling units going at peak capacity to make the overall job efficiency equal to shovels or scraper units at a 50 to 75-percent efficiency.

The percentages, then, are not necessarily comparative, and any attempt to make them so would have to be based on arbitrary rather than logical assumptions. They do indicate, however, that working efficiencies, like batting averages, may be hard to improve on, even though there is plenty of room for such improvement.

Weather was deducted from the Highway Research Board figures as being an item over which there is no control. Lost time due to it varied from 15 percent up to an extreme of 54 percent for the units studied.

The reports split all delays into major and minor categories, based on whether they were under or over 15 min in duration. Typical delays besides weather cover such items as:

1. Repairs, service, maintenance
2. Shortage of hauling units at loader, shovel, or paver
3. Waiting on pusher
4. Cleaning up
5. Short moves
6. Maintaining haul roads
7. Contractors' traffic
8. Deadheading, and waiting on auxiliary operations
9. Starting up or shutting down
10. Operator and personnel delays

Minor delays were found to vary from 6 to 51 percent for the seven machinery groups, and apparently increased with the complexity of the whole operation. It is simply the case of the juggler who, with seven eggs in the air, is more likely to drop one than if handling only three.

Repairs and maintenance requiring more than 15 min of delay, and therefore classified as major, consumed from 3 to 19 percent of the total available time. Without knowledge of the age, general condition, and extent of the repairs accomplished off shift, it is impossible to evaluate the spread.

In comparing parts of the reports with individual records, extreme care should be exercised to see that they are reduced to a common denominator. For instance, major delays are carried as a percentage of the total available time, and in the case of the rubber-tired tractor-drawn scraper, repairs to the unit appear as 3 percent, certainly a mechanical availability to be proud of. Ordinarily, although minor delays are known to occur, they are seldom recorded and thus become a part of the working time. Then mechanical downtime is the repair time divided by the net working time plus the repair time (other major delays excluded), and in this case the total changes to 8 percent.

The point is that, before the books are compared, it is necessary to make certain that they are being kept in the same manner. For instance, one record of four machines in our company files for a continuous period of 7,500 hours, excluding weather, shows a job efficiency of 81 percent. An attempt to convert the Highway Research Board report to the same basis results in a job efficiency for similar units of 76 percent. The difficulty is that the 5 percent edge looks good but smells very strongly of unrecorded minor delays.

There is no doubt in either case as to the validity of the figures—as far as they go. They may fail to coincide with any single, or cumulative set of data obtained elsewhere. They are probably incapable of being honestly compared. They do without question, however, form a conclusive weight of evidence to show that a genuine problem exists.

The problem is twofold—the mechanical complexity of the equipment and the operational complexity of the job. Where loading, hauling, and spreading conditions allow a choice, the equipment providing the simplest solution will quite often be the cheapest.

Since three basic types of equipment continue in the picture under the competitive-bidding method of doing work, it cannot be said that this is always true. If any generalizations are possible, they are that:

1. Materials that can be push-loaded into scrapers without prior breakage can almost always be handled at a lower cost with carrying scrapers than by other methods.
2. When speeds of 8 mph or better can be utilized, the rubber-tired prime mover should probably be used in preference to a tractor.
3. Under conditions of long, level cuts in friable materials, coupled with long high-speed hauls, the elevating grader may out-produce the scraper.
4. In tougher materials and heavy cuts the shovel and hauling unit should, on the average, produce lower costs.
5. Where material, excavated below haul-road grades, can be loaded into units on the road, eliminating low-gear hauls against an adverse grade, the dragline and hauling unit are probably indicated.

In conclusion, it must be said that in spite of all other factors, and unless the difference in cost is out of all reason, the contractor with $250,000 worth of idle scraper equipment will undoubtedly put it to work in rooted rock before buying a new shovel. It is just as true that the contractor whose operations involve mostly truck and shovel work will take on quite a volume of what would normally be considered scraper work, and buy new units for his current equipment group simply because future jobs would not justify the capital outlay for a fleet of scrapers.

As manufacturers, we sometimes wish it were possible to reduce the selection of equipment to a set of tables. If this is possible, we at least are without the formula. Given a set of operating conditions (materials, grades, haul-road conditions), we are often unable to predict, before working out the estimate in detail, which of our own machines of a given type but of different capacities and speeds, will present the most favorable cost picture.

TABLE I. Productive working time as a percentage of available time less weather delays

Equipment Type	Percent
Dual-drum pavers	52
Power shovels	53
Batch-type asphalt plants	62
Bituminous finishers	27
Rubber-tired, tractor-drawn scrapers	62
Crawler tractor-drawn scrapers	78
Loaders (elevating-grader type)	37

(This article was originally presented by Mr. Heiple at ASCE's Annual Convention, before the Construction Division session on "The Use of Construction Equipment.")

DWIGHT W. WINKELMAN, M. ASCE, President, D. W. Winkelman Co. Inc., Syracuse, N.Y.

Construction management needs the civil engineer

There are greater opportunities today for civil engineers in construction than at any previous time in the history of our country. These opportunities will enable civil engineers to take a basic and fundamental part in the conception, design and execution of projects which are essential to the growth, development and defense of our nation and its communities. These opportunities can lead to the personal satisfaction of having had an important part in the creation of facilities which serve the people and improve their lives, and to gratifying monetary rewards.

Of course there are some engineers who prefer to engage in the research which increases our knowledge and leads to better design. Other engineers prefer to enter the consulting field where they can design and administer projects. Others will prefer government service, where they will have important work in the conception, design or administration of projects or whole construction programs. It is essential that there be highly trained and competent men in these various branches of the profession, and there are many in these fields.

But my purpose here is to stress what I believe is the equal necessity for thoroughly trained and competent men to engage in the management of construction firms which actually build those facilities that are vital to the progress of the country.

One illustration will serve to outline the trend of my thinking. The President has dramatized our highway needs by speaking of a multi-billion-dollar program. For an investment of such magnitude, we should have research to learn how we can design better. It will take well-trained men of vision to conceive and design the projects that will fill our needs. And it will also take well-educated and experienced men in construction companies who can carry out that construction program with a maximum of efficiency and economy so that the public will receive the maximum value for its investment.

Importance of construction industry

In discussing opportunities for the young engineer in construction, we can start with the size and importance of the construction industry itself. Current estimates indicate that this year the value of new construction of all kinds put in place will be approximately $36 billion, which will establish a new record for the ninth consecutive year. When the value of maintenance and repair operations is added, the total value of construction activity for the year will be more than $50 billion. These figures are so big that they are hard to understand, but one comparison is that the value of construction this year will again be greater than the value of agricultural production.

One indication of the importance of the construction industry is that more than one dollar in every seven of the gross national product—the measure of goods and services produced in the nation during the year—represents construction activity. As to the future, so long as the nation continues to grow and develop, the construction industry likewise must continue to expand in order to provide the necessary physical facilities. The mere growth of the industry will provide increasing opportunities for engineers.

Need for engineers

There are other reasons why the construction industry offers greater opportunities for engineers. Great strides in engineering research and conception of projects to fulfill their purposes more exactly, improvements in design, better machinery and equipment, and other factors have made the construction of a project a more precise operation.

Today, more than ever, it is essential that construction firms have qualified and competent engineers on their staffs if their operations are to be carried out efficiently and economically. My understanding is that the need for engineers in the construction industry is about one-half the number of annual graduates.

It is interesting to note that the Construction Division of the Society is now its largest, and that about 40 percent of the members of this Division are in the contracting field as owners, managers, or corporate executives. In former years, many heads of construction companies had little formal education but gained their experience through working at one of the trades and becoming successful through hard work, initiative, and imagination.

The exacting requirements of modern efficient construction operations still require lots of hard work, imagination, courage and initiative, but they also require a sound understanding of engineering. This is another reason why I believe that the opportunities for engineers in construction are greater than ever before.

Management in construction

A subject which is close to my heart is the function and responsibility of management in construction. As we all recognize, a general contractor, or a consulting engineer or a subcontractor, is in business to make money and must do so if his company is to survive. But those of us in the contracting profession like to believe that we have a greater function than making money. We like to believe that we are a part of a team whose common objective is to provide the public with projects which most effectively fulfill their purpose at the lowest reasonable cost.

No matter how brilliantly a project

has been conceived or how perfectly it has been designed, it is not useful until it has been constructed by the contractor. And because construction is such a basic activity in the nation and its communities, we recognize our responsibility in seeing that the public receives the maximum value for its investment.

But our work is far from simple. We must understand the owner and designer so that the project will accomplish what it is supposed to. We must secure the materials and schedule their flow for arrival when needed. We must assemble the necessary skilled workmen and comply with a multitude of laws, rules, regulations, and customs in dealing with them. We must schedule the operations of the men and also of the equipment, which at times may cost as much as the amount of the contract. We must finance our operations.

In all kinds of locations we must conduct our operations so as to provide for the safety of workmen and the public. We need to train new men. We must retain good relations with the public so that we will merit and maintain their confidence. We must pay our taxes to various government units. And we must turn over to the owner a project of specified quality at the time agreed upon. We take the risk that the bid we submitted before work started may not prove adequate.

The contracting business always has been fiercely competitive, and it will continue to be so as far into the future as I can see.

Free enterprise system

We contractors do have our problems. But we also have the satisfaction of knowing that we have been part of the team which has made an important contribution to the community and the nation. For more than a hundred years, since the establishment of the ASCE in 1852, civil engineering has been recognized as a profession in this country. It is only more recently that the trend has been to recognize contracting as a profession also. The requirements of modern construction have made it essential to raise the standards of skill, integrity and responsibility in contracting to such a level as to make it a true profession.

Relationship of contractor to engineer

General contractors throughout the country are recognizing the greater need for engineers in their organizations and are constantly giving more thought to training engineers for management positions in construction.

Although I am chairman of the Education Committee of the Associated General Contractors of America, I do not want to go into detail about the work which the association and its more than 120 chapters and branches, as well as its more than 6,400 member firms, are doing along this line. But I can make a few generalizations.

There is a growing interest in consulting with educators on the curricula of engineering schools, in giving lectures on various phases of construction, on providing summer employment for students, in providing scholarships and otherwise helping schools and students. The AGC, because its membership is by companies rather than individuals, has abolished its student chapters in schools but cooperates with the ASCE Student Chapters.

While contractors and the AGC have helped to improve the salary scales for engineers in government agencies, they have also given consideration to adequacy of pay for engineers in contracting organizations. Contractors recognize the value of having the engineer, after his schooling, start on the ground floor and work upward in the organization, and they also are aware of the need to give a competent man greater responsibility and appropriate rewards for his work.

Heads of contracting firms who properly regard their business as a profession are also increasingly aware of the young engineer as a professional man. Many AGC companies encourage their engineers to join the American Society of Civil Engineers if they have not already done so, and to become active in its affairs.

Today the engineer who has a sound engineering understanding, and also the ability to handle executive, managerial and general business matters, has an excellent opportunity to play an important part in the management of his own or some other construction firm.

In some parts of the country efforts are being made by labor unions to bring civil engineers in certain kinds of work into unions. The Labor Management Relations Act does not exempt professional engineers from possible union membership, but it does provide that professional engineers need not be members of unions with non-professional engineers unless a majority so decide.

There is no need here to go into the legal complications of this subject. The Board of Directors of ASCE, and the Engineering Joint Council, have adopted a policy statement which is compatible with the law and which I believe is appropriate. That statement, which follows, was endorsed by the full board of the AGC at its St. Louis meeting in September:

"(1) Any group of professional employees, who have a community of interest and who wish to bargain collectively, should be guaranteed the right to form and administer their own bargaining unit and be permitted free choice of their representatives to negotiate with their employer.

"(2) No professional employee, or group of employees, desiring to undertake collective bargaining with an employer, should be forced to affiliate with, or become members of, any bargaining group which includes non-professional employees, or submit to representation by such a group or its designated agents.

"(3) No professional employee should be forced, against his desires, to join any organization as a condition of his employment, or to sacrifice his right to individual personal relations with his employer in matters of employment conditions."

My personal reaction is, and I believe that practically all contractors would join with me, that the way ahead in the management field in the contracting profession for a civil engineer does not lie through membership in a labor union but through recognition as a professional man capable of handling executive, managerial, and business affairs.

In concluding, I would like to stress that construction has become the greatest single industrial activity in America, and that the products of construction are essential to the growth, progress, and defense of our nation and our communities.

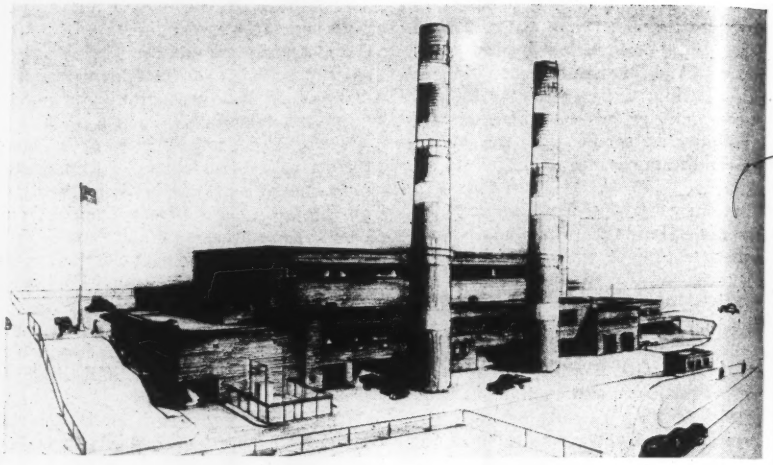
The importance of the facilities which help to improve our standards of living, and the importance of the volume of construction to the national economy, are a challenge to those who help to create the projects involved. There is also the responsibility to conceive and design these projects so that they fulfill their functions most effectively and are constructed most efficiently. Management in the contracting industry, which is responsible for the construction operations which bring these facilities into being, has developed to the point where contracting can be recognized as a true profession.

Management needs the civil engineer with construction experience and managerial and executive ability. In this field the engineer has an opportunity to reap not only monetary rewards but also the satisfaction of accomplishing important work for society.

(This article is based on Mr. Winkelman's address at the ASCE Annual Convention in New York, delivered before the Conditions of Practice Session, sponsored by the ASCE Committee on Junior Members and the Metropolitan Junior Branch, with Jewell M. Garrelts, Chairman of the Committee, and Eugene D. Jones, President of the Branch, presiding.)

ROY H. RITTER and
R. C. REGNIER, MEMBERS ASCE

Partner and Associate Engineer respectively
Whitman, Requardt and Associates
Baltimore, Md.



New Incinerator No. 4 is scheduled for completion in July 1955. Design takes advantage of experience with Incinerator No. 3, now handling 700 tons per day of mixed refuse.

Old plant guides design of NEW BALTIMORE INCINERATOR

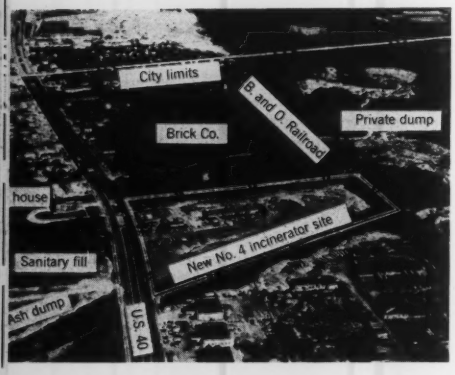
Lack of space for sanitary landfills within the city limits of Baltimore made it necessary for the city to proceed rapidly with the construction of new incineration facilities. Obsolescence had taken its toll of two of the city's three plants. The capacity of the only remaining plant, Reedbird No. 3 Incinerator, was increased 33 percent by installing hydraulically operated stokers. The construction of the new incinerator, No. 4, is costing the city $2,861 per ton of capacity at its 800-ton rating. The overload capacity is estimated at 1,000 tons per day. In the design of this new plant, of the pit and crane type, full advantage has been taken of the city's past experience in the incineration of its refuse. This plant, together with the old No. 3 plant, should be able to meet Baltimore's needs for twenty years.

In 1953 the operating cost of the Bureau of Sanitation was $4,655,000, and 1,214 persons were employed. Refuse was collected two days each week using 100 crews composed of one chauffeur-foreman and three loaders. Collection was done by the "task system," whereby each crew has an assigned task which is considered to be one day's work.

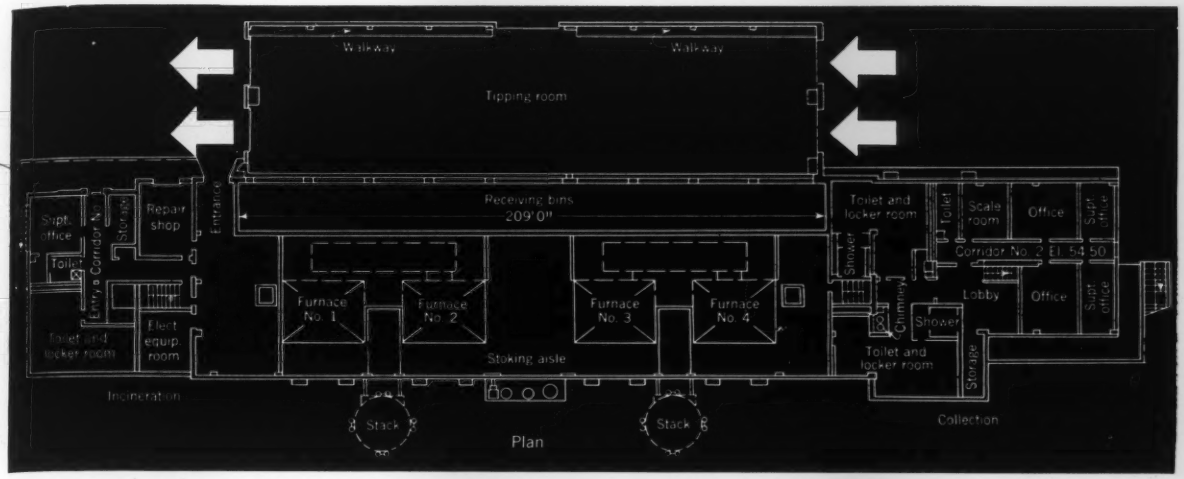
The amount of garbage is unlimited but refuse is limited to four 20-gal containers for each collection. During the calendar year 1953, a total of 366,000 tons of mixed refuse, or 1,000 tons per day, were collected from a population of one million persons. Of this amount, 310,000 tons were collected by the city at a cost of $2,045,000, or $6.59 per ton. The remaining 56,000 tons were hauled by private collectors to Incinerator No. 3. In 1953 the city used 120 load packers at an average cost of 0.39 cent per mile, or $2.23 per hour. The average haul to the incinerator was about five miles.

Incinerator No. 3, located adjacent to the busy U.S. Route 301 to the south, was constructed about twenty years ago and was operated privately for ten years. At the time it was constructed, 65 percent of the mixed refuse was garbage, whereas today garbage comprises only 35 percent of the mixed refuse—probably because of modern merchandising and packaging methods. Several years ago hydraulically operated stokers were installed in all the four furnaces at this No. 3 plant. The original capacity of 600 tons was at the rate of 50 lb per sq ft of grate per hour. Since the hydraulically operated stokers were installed, the plant has been operated continuously for thirty days at the rate of 800 tons per day, or 66 lb per sq ft of grate per hour. This 30-day test rate was increased by 10 percent during one 24-hour test period.

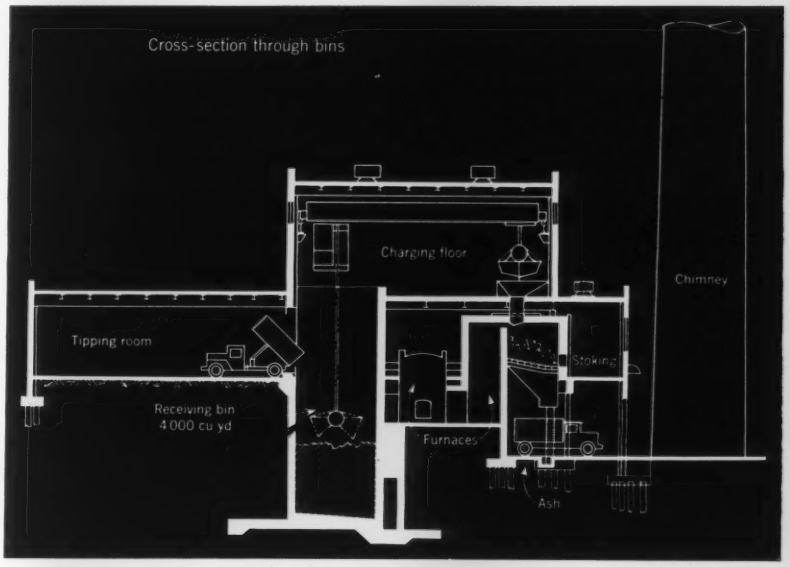
For the past twenty years all mixed refuse in Baltimore has actually been weighed on plant scales. In 1953 the existing incinerator burned 203,000 tons of mixed refuse at an operating cost of $293,000, or $1.44 per ton.



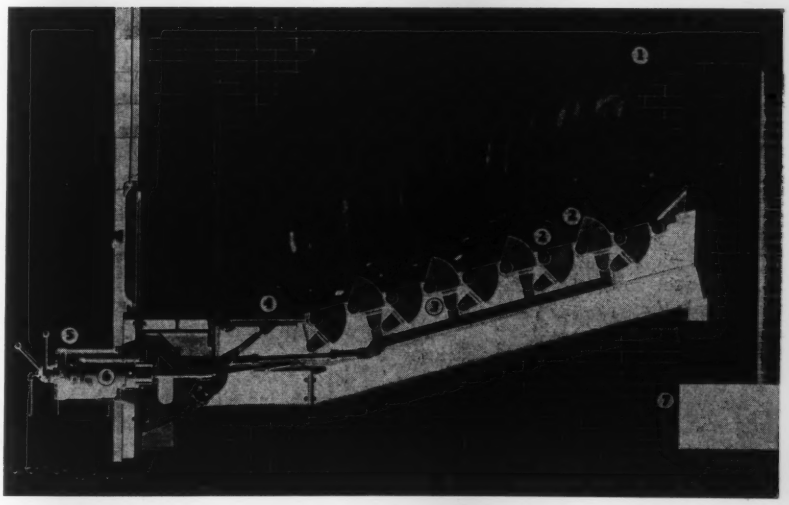
Baltimore's new incinerator is being built on site of an old city incinerator, near sanitary land fill, in future to be used as ash dump. Ten acres available for building site will be ample for landscaping and parking area.



Above:
Fig. 1. In new incinerator building, collection division offices and plant operation offices are separated by incineration facilities. These operations are thus kept completely independent.



Right:
FIG. 2. Natural slope of site permits both dumping of refuse and ash removal to be performed at ground level. Charging zone has three cranes, two for operation and one standby. Each of the four furnaces has four charging hoppers.



Right:
FIG. 3. Furnaces in new incinerator are of type previously found efficient in Incinerator No. 3. Main features are: (1) Area where refuse is charged into furnace is hottest zone, producing most rapid drying action; (2) alternate moving stoker bars, hydraulically powered, provide agitation and move material along; (3) stoker bars are designed to free themselves automatically of any metallic refuse; (4) dumping grates are dumped at will of operator without lowering furnace temperatures; (5) hydraulic cylinders operate alternate-moving stoker bars; (6) hydraulic cylinders operate dumping grates; (7) combustion air, entering beneath, passes through lower end of stoker and over entire burning mass. The equipment was manufactured by Flynn & Emrich, of Baltimore, Md.

The site selected for the new Incinerator No. 4 is the same as that of the old Incinerator No. 2, which had been abandoned and razed. Incinerator No. 1 was abandoned some time ago because of its small capacity and high operating cost.

For the past ten years the city has been operating a sanitary fill adjacent to the site of the new Incinerator No. 4. After the sanitary fill is abandoned, next year, there will be sufficient area available to dump the ashes from the new incincerator. The 10 acres available will therefore be ample for the construction of the new incinerator and the landscaping of the site.

During the year 1953 the sanitary fill disposed of 201,000 tons of mixed refuse, ashes, and street dirt at a cost of $110,000, or 55 cents per ton. About 12 percent of this was ashes and street dirt and the remainder mixed refuse. By comparison the refuse hauled to Incinerator No. 3 contained less than 1 percent of street dirt.

The need for Incinerator No. 4 is urgent because the land at the existing sanitary land fill is quickly being used and there are no other practicable sites within the city limits.

The operation of Incinerator No. 3 has been so efficient that this same type design and equipment were adopted for the new incinerator. (See Figs. 1, 2, and 3.) This is designed for a nominal capacity of 800 tons at the rate of 58 lb per sq ft per hour. However, it is believed that the plant can handle as much as 1,000 tons per day at a rate of 72 lb per sq ft of grate per hour.

The new plant will be of the pit-and-crane type with two pair of rectangular furnaces. A common expansion chamber and stack will serve each pair of furnaces. The sloping site permits collection trucks to dump into the bin on the high side of the building while the entire opposite side, at a lower level, is available for access to the ash floor (Fig. 2). Ashes may be dumped from the water-quenched ash hoppers directly into the dump trucks or into portable containers for removal to the ash dump.

The building is of steel frame and brick masonry construction with a concrete substructure founded on poured-in-place concrete piles. Every effort was made in preparing the design to restrict the amount of labor required to maintain the building in an attractive manner.

Red brick was selected for the facing, and a dark manganese brick as an accent in the panels adjacent to the windows. Aluminum sash, door frames, and metal trim are used throughout. Interior walls are finished with structural glazed facing tile. Floors in general are of hard troweled concrete with integral hardener in areas exposed to heavy wear. Some colored concrete and rubber tile are used in office areas, and quarry tile is used in the locker rooms.

In addition to the facilities for the operating personnel, provision has been made in one of the two wings of the building for office space, locker and shower facilities for two of the five districts of the Collection Division. This includes office and locker space for 16 supervisory and clerical employees and four shower and locker rooms, each for 100 men of the trucking crews. This space for the Collection Division, while in the same physical structure, is completely separated from the operating part of the building. See Fig. 1.

The second wing, containing the office of the incinerator personnel, includes a superintendent's office with private toilet facilities, a toilet and locker room for foremen, a toilet and locker room for 69 members of the operating staff, a repair shop and a separate room for the enclosure of electrical switchgear, central telephone equipment, and the control equipment for an intercommunication and paging system. On the lower floor, accessible to trucks from the ash floor drive, is a storage area of 4,000 sq ft for firebrick, maintenance, and operating supplies. A small separate building will provide for the storage of inflammable materials and lubricating oils for the trucks.

Between these two wings is the operating part of the building. The trucking floor, or tipping room, extends 200 ft for the full length of the receiving bin and is 50 ft wide from curb to curb. In each end of the tipping room there are two 14-ft doors. One door at each end is motor-operated. In the center of the side opposite the receiving bin, there is a fifth door with an 18-ft clear height, which provides for peak periods. Vertical clearance inside the tipping room is 20 ft to provide clearance for trucks in the dumping position.

The receiving bin is 209 ft long by 17 ft wide and is 30 ft deep. This provides a total capacity of 4,000 cu yd, or about 1,000 tons of mixed refuse. The floor of the bin, and the walls up to the trucking-floor level, are faced with steel rails on 18-in. centers, set with the flange in the wall and the head projecting $1/4$ in. beyond the face of the wall. This is done to protect the concrete wall from damage by the crane buckets.

The cranes for lifting refuse from the receiving bin to the charging hoppers will be of 3 $1/2$-ton nominal capacity, equipped with 2 $1/2$-cu yd grab buckets. Experience at Incinerator No. 3 has shown that two cranes are required to maintain the rated capacity of the plant. A third crane has been added so that, during periods when one crane is out of service for maintenance or repair, there will still be two cranes available for operation. The crane rails and the charging floor are so arranged that a crane can be parked at either end or in the middle of the building while all the charging hoppers are still clear for use.

The charging hoppers are of welded steel construction. A total of 16 openings are provided, there being four openings, each of 12 sq ft, in each of the four furnaces. The charging gates are pneumatically operated, with the controls mounted near the front of the furnace on the stoking floor. The charging openings are so arranged that each charge will be deposited at the rear of the furnace on a sloping grate composed of alternately moving parts. This is the type of grate which has been in successful operation in Incinerator No. 3 since April 1953. The grate bars, manufactured by Flynn & Emrich, are segmental in cross section, and alternate bars are raised and lowered by a hydraulic system controlled by the stoker from the front of the furnace (Fig. 3.) The alternate operation of the grate bars agitates the charge and at the same time moves the burned material from the rear to the front of the furnace.

The ash dumping grates are at the front of the furnace, where the stoker can see the condition of the burned material being discharged into the refractory-lined ash hoppers, equipped with a water-quenching system. The ash hoppers are each equipped with cast iron sliding gates hydraulically operated, with controls located at strategic points along the ash removal floor. While there are four gates for each of the four furnaces, the hoppers are arranged in pairs so that two adjacent hoppers will discharge into one truck body or container.

Lack of ventilation of the ash floor at the existing Incinerator No. 3 has been quite a problem. At that plant the ash-removal trucks are loaded in the basement. Smoke, steam, and water vapor have made it impossible at times to remove the ashes. At the new plant, the side of the ash floor opposite the furnaces has a continuous row of rolling doors, admitting both fresh air and natural light.

To hold the nuisance of smoke and water vapor on the ash floor to a minimum, a system of ductwork has been provided to the rear of the ash gates so that the forced-draft fans for the furnaces can take suction from this point. The fans can perform the combined function of high-volume ventilation of the ash floor together with discharge of the gases either into the

furnaces for combustion air, or into the annular space between the chimney shell and the lining for discharge into the atmosphere. Motorized dampers are provided to permit adjustment of the quantity of air to be used in the furnaces or to be exhausted.

Because of the continued trend toward higher proportions of readily combustible materials, control of high furnace temperatures is becoming more important. To assist in this control, provision is being made for the introduction of controlled quantities of outside air into the furnaces above the fire bed. This air is supplied through a system of ductwork with independent fans. At the same time, two auxiliary oil burners are furnished in each furnace for ignition and control of low furnace temperatures. Indicating and recording pyrometers are included in the furnace equipment but the controls of the forced-draft and over-fire air systems are manual.

A furnace control panel will be located at the center of each pair of furnaces on the stoking floor. On these panels, easily accessible to the stoker, will be located an electrical distribution panel, the oil-burner controls, the overfire air controls, the forced-draft fan controls, and the indicating pyrometers. A recording pyrometer, recording temperatures in each furnace, will be located in the main corridor near the superintendent's office for the use of the superintendent and foreman.

To facilitate handling of grate bars, firebrick, and other heavy and bulky maintenance materials on the furnace floor, provision has been made for inside truck access along the entire stoking floor.

During the design period, consideration was given to the reclamation of heat generated from the burning refuse. However the studies indicated that at this plant waste-heat reclamation was not economical. Hence independent, oil-fired facilities are provided for heating the occupied part of the building.

At Incinerator No. 3, as at most refuse incinerators, the removal of fly ash and clinker from the expansion chambers and flue spaces has been a serious operating problem. The new plant is designed to reduce the inconvenience and the down time required for this operation. A central vacuum cleaning system is to be installed with large outlets adjacent to the clean-out doors so that most of this material can be removed without the usual amount of hand labor. It is anticipated, however, that under some conditions clinker will be formed which cannot be removed by the vacuum system. The same vacuum equipment will serve a separate vacuum piping system for general housekeeping.

A water spray system will be installed along the walls of the receiving bin to reduce the dust on the tipping room and charging floor. The water spray nozzles have been designed so that the entire plan area of the bin is covered at a proper height for controlling the dust without wetting the truck bodies and without adding an excessive amount of water to the refuse.

In the rear of the building a parking area is provided for the collection trucks of the Bureau of Sanitation. If required in future, an additional parking area can be laid out on the south side of the building. Lubrication, maintenance, and repair of all vehicles are performed in a central garage. However, provision is made at the new incinerator for fueling and washing of collection trucks. The wash stands are provided with compressed air, water, electric power, fuel-oil storage, and drainage facilities. Portable hot water and steam generators will be purchased through the normal city channels. On the south side of the building, along the entrance driveway, a separate building is provided for the storage of lubricants, inflammable materials, and for the fueling of vehicles. Here, as in the main building, the space occupied by collection personnel is entirely separated from that occupied by incinerator personnel.

Disposal of animal carcasses is basically a function of the Bureau of Sanitation. Normally large animals present no problem since they are welcomed by rendering and fertilizer plants. Depending on market conditions, however, these plants are sometimes unwilling to accept smaller animals. Although small carcasses are now being accepted by commercial establishments, facilities are available for their destruction at Incinerator No. 3, and similar provisions will be available at the new plant.

Salvage operations for certain materials are now conducted at the existing Incinerator No. 3, but because of the high labor cost, poor housekeeping and lack of markets, no salvage facilities will be installed at the new incinerator. Non-combustible items too large for the incinerator will be hauled to the ash dump.

The construction cost of $2,861 per ton is based on a nominal capacity of 800 tons, and if the predicted overload capacity of 1,000 tons can be obtained the cost will be only $2,300 per ton. Table I lists pertinent design data and construction costs for the new incinerator.

The building construction contractor began work in July 1954. Under the terms of the contracts, both the building and the equipment contractors are to complete their work by July 1955. The equipment installation and furnace erection will begin early in 1955.

The project is being constructed by the Department of Public Works of the City of Baltimore, with George A. Carter, M. ASCE, Acting Director; R.E.L. Williams, Building Construction Engineer; and William P. Fannon Sanitary Engineer. Whitman, Requardt and Associates prepared the plans and specifications for Incinerator No. 4 and are supervising its construction. The Bureau of Sanitation of the City of Baltimore, under the direction of William P. Fannon, Sanitary Engineer, is responsible for the collection and disposal of all mixed refuse as well as all street cleaning operations.

TABLE I. Design data and construction cost for Baltimore Incinerator

Design Data:

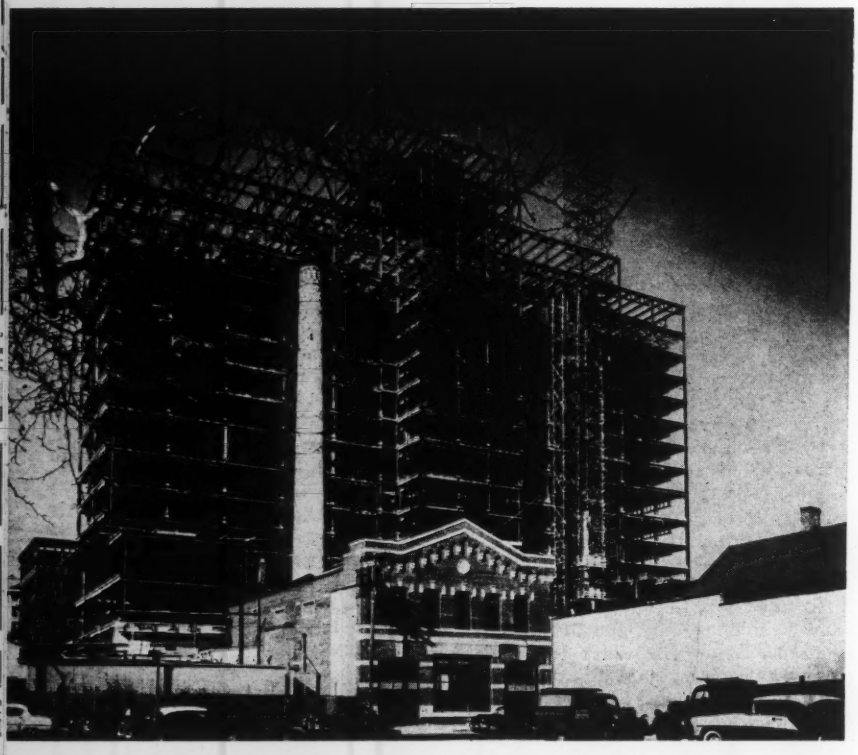
	Each Furnace	Total Plant
24-hour capacity	200 tons	800 tons
Predicted overload capacity	250 tons	1,000 tons
Furnace volume	2,250 cu ft	8,900 cu ft
Grate area	290 sq ft	1,160 sq ft
Combustion chamber	3,400 cu ft	13,600 cu ft
Expansion chamber	....	9,520 cu ft
Two chimneys	12-ft dia × 150-ft height	
Three cranes	3½-ton, 2½-cu yd	
Truck scale	20-ton, 24 × 10-ft platform	

Construction cost:

	Cost per Ton	Total Cost
Equipment contract	$ 963	$ 770,232
Building contract	1,898	1,518,300
	$2,861	$2,288,532

WELDING adopted for

MICHAEL J. COLARUSSO, Superintendent, Walter Kidde Constructors, Inc., New York, N.Y.



Steel frame for Harrison S. Martland Medical Center was topped out in November 1954 after weathering hurricane of October 15 without damage. Steel work was then 9 stories ahead of floor concrete. Narrowness of this 17-story building required substantial wind bracing of columns from bottom to top. Photo by Gottscho-Schleisner.

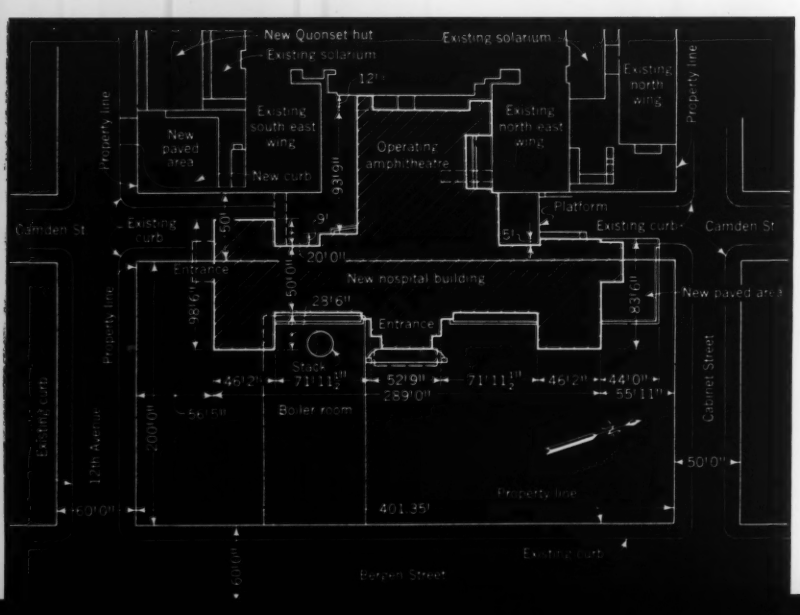


FIG. 1. Hillside plot and existing hospital buildings required careful scheduling of demolition of old structures and construction of new medical building in Newark, N. J.

A traditional tree-raising ceremony on November 22, 1954, marked completion of steel erection for the new 9-million-dollar Harrison S. Martland Medical Center in Newark, N.J. An outstanding feature of the 17-story structure is that all primary connections between beams and columns, and between beams carrying elevator loads or operating machinery such as that for the ventilating system, are of welded construction. Secondary connections are shop riveted and field bolted.

The new building is an addition to a 50-year-old hospital made up of four- and five-story buildings formerly known as the Newark City Hospital. When completed, the structure will serve as a 738-bed hospital, nurses training school, and clinic. See Fig. 1.

Construction difficulties on this project stemmed primarily from the hillside location and the need to maintain hospital functions. Before excavation could start, it was necessary to raze existing non-hospital buildings which included an old leather goods factory and a number of wood-frame structures. In addition, a number of hospital buildings—including a laboratory, pharmacy, morgue and chapel, annex and laundry—had to be demolished. At no time could hospital services be interrupted.

This latter specification was met successfully by Walter Kidde Constructors, but only through close scheduling of demolition and careful coordination with the hospital staff. The first step was the erection of a 140 × 50-ft Quonset hut to temporarily house the hospital's laboratory, morgue, and blood bank. An old garage was altered and repaired by putting in new concrete floors to transform it into a laundry.

To keep hospital services as nearly normal as possible, facilities were moved in two stages. For instance, the pa-

17-story hospital in Newark, N. J.

HEATHCOTE W. LAWSON, M. ASCE, Assistant Chief Engineer, Schacht Steel Construction, Inc., Hillside, N.J.

thology laboratory had two tables, sinks, and other duplicated facilities. First, half of the laboratory equipment was transferred and set up in the new location, and only after it was in full operation was the rest of the laboratory relocated. This procedure was followed for the entire relocation program—even laundry facilities were moved in a number of stages. As a result, despite the bustle and confusion attendant on a construction project, hospital operations and services were maintained on an even keel.

No blasting for excavation

Razing of existing structures was a simple matter; the buildings were old and in disrepair and most of them had no foundations to speak of. Walls had spread footings in a heavy clay soil just below grade. Once the site was cleared, the excavation work was a more exacting operation. Because of the close proximity of existing buildings—within 20 to 25 ft—the contractor was not able to blast out the shale rock. Not only would the blasting cause bothersome noise, but there was a possibility it would damage existing structures.

Instead, it was necessary to line-drill the rock and further break it up with paving breakers. When excavation was completed, approximately 3,000 cu yd of rock had been removed. The excavation depth for the basement was 26 ft, and the column footings were put down 4 to 8 ft deeper.

The steel erector, Daniel Klockner, Jr., Inc., had difficulty getting steel in to the job site, where it would be easily accessible. There was almost no room to work in, since the 27,000-sq ft job site was hemmed in by existing hospital buildings. To ease the situation, foundation-wall pours around the main entrance area were held up so that a crane could be maneuvered in to set steel up to the third floor. Then two derricks were erected, one on the north side of the entrance and one on the south side, and the foundation walls were completed. Steel was then set with the derricks.

Welding gives savings

A return to more competitive conditions in the steel fabricating industry has revived interest in the use of welding as a fabrication technique for steel frame structures. As a result, when alternate bids were requested for the new hospital addition, it was recognized that the structure would lend itself to welded fabrication.

Obviously it was highly desirable to eliminate the noise of field riveting because of proximity to existing hospital buildings. This structure compares favorably in size with hospital buildings in other large cities, since it is 17 stories high with a base of over 36,000 sq ft. The structural consultants, Lars I. Moe & Son, Jersey City, N.J., designed the frame.

The steel contractor submitted an as-erected bid, on a riveted basis, of $1,084,000, and this figure was reduced by $113,000 for a shop and field-welded design. The nearest competitive bidder offered $1,081,000 for a riveted design and $84,000 less for a welded one. The low bidder was Schacht Steel Construction, Inc., of Hillside, N. J.

In the redesign for welded primary connections, all column and beam sizes were retained. Nevertheless, a saving in total steel weight of about 6 percent was obtained, reducing the overall steel requirements from 3,380 to 3,195 tons. Further economies resulted from the welded design. Because of the thickness of the metal in the columns, it would have been impossible to punch the holes for riveting; instead, expensive drilling would have been necessary. This expense was of course greatly reduced by welded fabrication.

Especially when wind bracing is required, a riveted joint tends to be heavy and rather cumbersome. Standard practice for a riveted structure is to use heavy angles and channels for the upper stories, with T-connections on the lower stories where wind stresses are greatest. T-sections are made from split I-beams and must be heavy enough to take the moment which occurs in the area between the center of the rivets and the fillet of the web. Further, the web must be wide enough to take four or five lines of rivets spaced about 3 in. apart.

In comparison, the welded joints are simple, clean and light. Mr. Lawson designed the welded connections in close cooperation with Ingvald L. Moe who was in charge of design and supervision for the structural engineers. The flange of the "T," used in a riveted connection between beam and column, was eliminated and a single plate was welded to the top flange of the beam with a fillet weld and then butt welded to the column, as shown in Fig. 3. All field welding was designed for downpass butt or fillet welds.

In the construction of multi-story hospital buildings, it has been found that the pouring of concrete floors can rarely keep up with the erection of steel because of the time required to install the large amount of electrical and mechanical equipment. This is particularly true when the steel is field welded. For these reasons, the columns were windbraced all the way up to the top floors, anticipating that concrete pouring might lag 8 to 10 floors behind steel erection. A typical wind bent is shown in Fig. 2. This decision was justified during the hurricane of October 15, 1954, when the steel frame was 9 stories ahead of the concrete. A complete check after the storm showed no distress in the welds and all columns plumb except one which was $1/2$ in. out

Excavation for basement was carried 26 ft below grade through shale rock without blasting. Blasting was ruled out to avoid danger to adjacent buildings, and more particularly to eliminate noise.

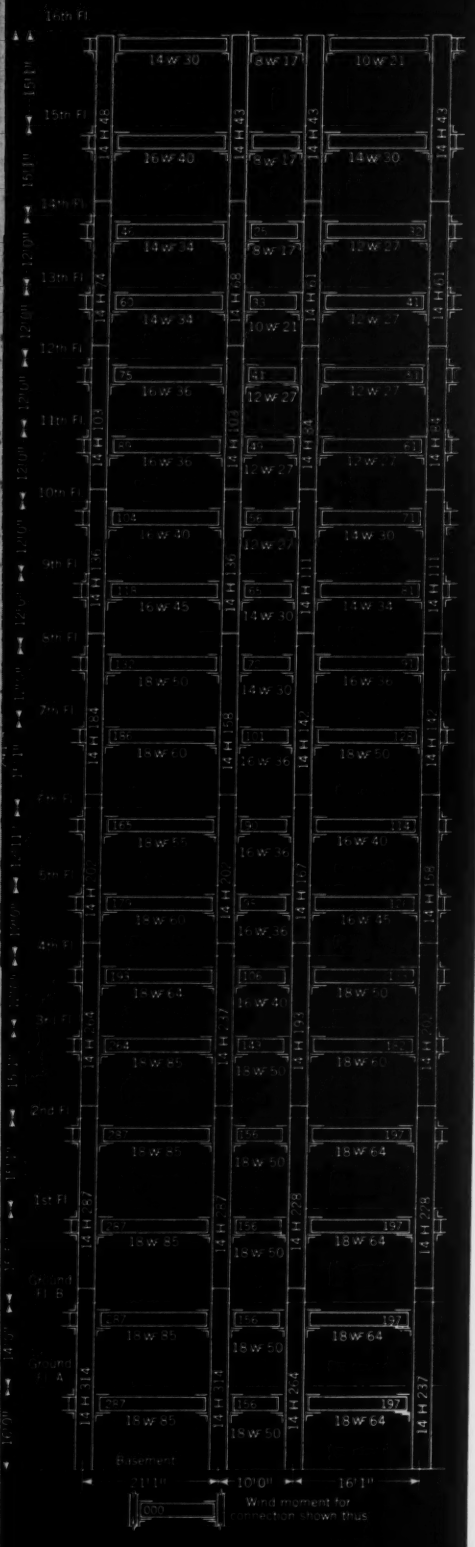


FIG. 2. Sizes of columns and beams and maximum wind moments are indicated for typical wind bent.

First column was set in June 1954. Photo by "Welding Engineer."

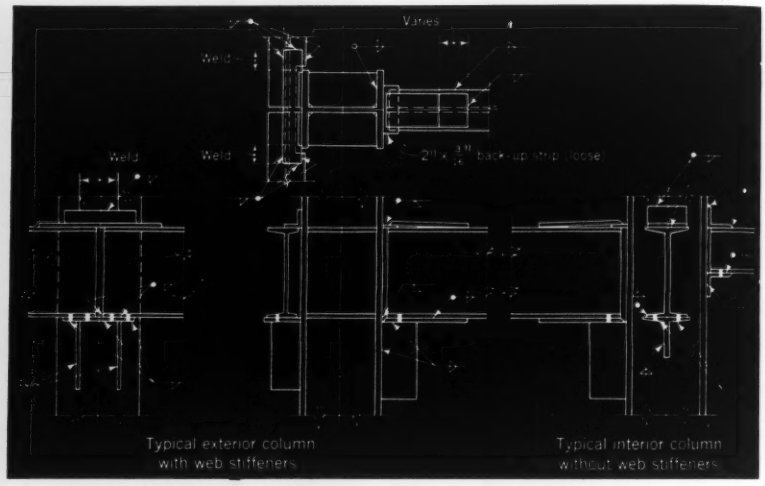


FIG. 3. Welding of main connections reduced weight about 6 percent and erection cost about 10 percent.

Below:
Construction below grade is of reinforced concrete. Excavation close to existing boiler house and stack, at right in photo, was one of contractor's touchy problems. No blasting was permitted.

Field connections were designed for down-pass butt and fillet welds. Field sketches generally were unnecessary. Ends of wide-flange column sections were milled for full bearing and aligned by welding of plate over joint. Bolts on flange, at right in close-up view, act as guides only. Photos by "Welding Engineer."

because of incomplete welding when the storm broke. This was easily straightened.

Drafting-room economies

An important phase of welding fabrication is proper detailing for the drafting room, fabrication shop, and field. The welding technique is less familiar to men on the job and there is a certain amount of psychological 'bucking" on the drafting board when a welded design is involved. Further, in the shop and in the field, detail sheets can get out of hand if a good system is not devised. A cumbersome system slows up the job and opens the door to errors.

On this project, a system of code marks for each piece was developed so that details could be standardized to a degree which greatly simplified drawings, fabrication, and field work. Field welds were so designed and located that field weld sketches were virtually eliminated. This represented a considerable saving both in the drafting room and in the field.

Field welding at a minimum

Although it is difficult to estimate the percentage of shop welding as compared with field welding, certainly a major part of the welding was completed in the shop. Indeed, this was one of the basic aims of the designers of the details. In the main, field welding was a simple, straightforward, repetitive operation. In most cases the weld operation is obvious, that is, the length of the weld and the thickness of the pieces to be fastened is easily seen. For special work, such as the framework for the operating theater, details were put directly on the erection sheets.

Approximately 12 welding machines, including d-c motor-generator sets and a-c transformers, were used in the shop. In the field a maximum of eight machines, including d-c rectifiers and d-c motor-generator sets, were used. In the field the welding rod was $^3/_{16}$-in. E6012; in the shop, $^1/_4$-in. and $^3/_{16}$-in. E6020 and E6012 were used.

The substantial saving in labor on welded fabrication as compared to riveting is readily apparent. A riveting team consists of four men—a heater, catcher, bucker-up, and riveter. A welding team consists of one man, the welder. Welding machines are grouped at a central location, and feed lines are simply run up to the work area.

In driving hot rivets, it is not possible to fill all the holes completely. As a result there is a certain amount of yielding in a joint due to rivet slippage. Since there is no slippage in a welded connection, a "stiffer" structure is obtained.

Concrete and finish work

In the design stage, several types of floor were studied and compared for costs and general flexibility, to provide for probable changes in room layout and equipment with advances in medical science and the treatment of patients. Short-span, stone concrete slabs supported on steel beams, designed as composite beams, were chosen.

All beams, except spandrel beams, were encased in 2,500-psi concrete for fireproofing. The structural steel was designed in accordance with AISC specifications. To secure composite action of the concrete slab, beam encasement, and steel beams, the latter were wrapped with wire-mesh caging and wire spirals as haunch and soffit reinforcement. The resulting composite-beam design resulted in a saving of approximately 10 percent in weight of the steel beams.

The floors required approximately 300 cu yd of stone concrete. Three tower hoists were used—one for brick and masonry and one for concrete. A third nine-story hoist on the west side supplemented the brick and masonry tower until the concrete tower was free.

The base is being finished with a granite course, the center and main entrance with granite and limestone. Exterior masonry will be finished face brick. The interior will have tile wainscoting and terrazzo with hung ceilings finished with plaster and acoustical tile. Ziegler, Childs & Paulsen of Jersey City, N.J., are the architects.

Floor beams are encased in 2,500-psi stone concrete, poured integrally with floor to take advantage of composite beam action. Exterior masonry will be finished face brick.

President Eisenhower's Advisory Committee reports on

A national highway program

Letter transmitting report

DEAR MR. PRESIDENT:

The plan submitted herewith, for modernizing America's road and street network, was prepared in response to your request of September 7, 1954, to the Advisory Committee on a National Highway Program.

The Committee has received a great deal of factual data, documenting the urgent need to improve our highways as quickly as possible, to prevent tragic and costly accidents, to serve the national defense, and to provide facilities essential to our growing population and economy. As you stated to the Governors' Conference on July 12, 1954, through Vice President Nixon, our road network is inadequate and obsolete, and its improvement calls for immediate and earnest attention.

So far as availability of materials, contracting capacity, personnel and administrative machinery are concerned, the doubling of our present road construction program, which the studies indicate as the magnitude of need, is entirely feasible. A difficult problem, of course, is finance, a responsibility shared by all levels of government. The Committee is confident that if the Federal Government, as proposed herein, increases its share of the total construction program to about 30 percent of the total, the states and local units of government also will correspondingly step up to this challenge.

The plan recommends authorization by the Congress of long-term financing, with existing federal-aid continued and additional funds concentrated for 10 years on modernizing the key 40,000-mile National System of Interstate Highways. It would, in effect, be a self-liquidating program since the funds to be capitalized would be equivalent to the revenues anticipated from federal taxes on gasoline and lubricating oils. It will achieve our objective while entailing no increase in either the federal tax rates on these items or the national debt limit.

Early in 1955 the Bureau of Public Roads, pursuant to a directive of the Congress, will submit a comprehensive report on its current study of highway needs and financing. The estimates used by this Committee have been based upon preliminary tabulations of data by the Bureau, and hence no major inconsistencies are anticipated.

Acknowledgment is made to the Governors' Conference, for counsel and suggestions; to the Inter-Agency Committee, reflecting the views of various departments of the Federal Government, and to more than a score of organizations whose representatives gave useful information and assistance. The Committee's special thanks are due the Bureau of Public Roads, whose capable personnel and resources were indispensable, and to a small group of consultants who worked indefatigably in the preparation of this report.

Respectfully submitted,

Lucius D. Clay, *Chairman*
Stephen D. Bechtel
David Beck
S. Sloan Colt
William A. Roberts

January 11, 1955

A financing program (*Part V of Report*)

The federal share

The responsibility for financing road and street construction in the United States is shared by federal, state and local governments, with the states and local governments assuming the major portion. If the recommendations of the Committee are accepted, the federal portion of the cost for this $101 billion of needed highways would be about 30 percent of the total, leaving to state and local units of government the responsibility to finance the remaining 70 percent.

The additional responsibility accepted by the Federal Government in this program is for the development of the Interstate System together with its essential urban arterial connections. The existing federal interest in our 3,348,000-mile network of highways remains unchanged.

This interest as expressed in the Federal Highway Act of 1916 in its presently amended form authorizes federal contributions of $315 million to the Primary System, $210 million to the Secondary System, and certain amounts to urban routes and to routes on public lands.

The Committee believes these contributions are essential to a balanced program. The funds now authorized for urban routes could be reduced to $75 million per year, because much of the work to be done with these funds as previously authorized is within the Interstate System. Forest Highway funds in the amount of $22.5 million per year should be continued.

The amount of the continuing annual federal-aid program, over and above the requirements of the Interstate System, which we recommend, is tabulated herewith:

Federal-aid Primary System . .	$315 million
Federal-aid Secondary System .	210 million
Urban extensions of these two federal-aid systems into cities not on the Interstate System .	75 million
Forest Highway System . . .	22.5 million
Total	$622.5 million

Specifically, we recommend:

1. That the Federal Government assume primary responsibility for the cost of a modern Interstate Network to be completed by 1964, to include the

Conclusions and recommendations summarized

1. A safe and efficient highway network is essential to America's military and civil defense, and to the economy. The existing system is inadequate for both current and future needs. It must be improved to meet urgent requirements of a growing population and an expanding economy.

2. Total construction needs of all highway systems during the next 10 years are estimated at $101 billion, including completion to modern standards of the 37,600 miles of the presently designated National System of Interstate Highways. The present program, if continued unchanged, would make available for highways during that period approximately $47 billion, leaving a gap of $54 billion.

3. The Committee concurs with the Governors' Conference in recommending to the President that the federal share of this needed construction program be increased to about 30 percent of the total, with states, cities, counties, and other agencies remaining responsible for financing the remaining 70 percent.

4. The interstate network is preponderantly national in scope and function. Modernization of the presently-designated system in 10 years, together with the most necessary urban connecting arterials, is estimated to cost $27 billion. It is recommended that state and local participation be $2 billion of this amount, which would continue the present responsibility of the states for this system.

5. Since roads are a capital asset, it is recommended that the federal share of interstate construction be financed by bonds to be issued by a Federal Highway Corporation created for this purpose by the Congress. The cost of the Interstate System improvement, together with the total authorized funds under the regular federal-aid highway program to the states, would approximate the revenues which the Federal Government will derive from the motor-vehicle fuel and lubricating oil taxes projected at the present rates.

6. The Federal Highway Corporation should have a Board of Directors to be composed of three citizens appointed by the President and confirmed by the Senate with the Secretaries of Treasury and Commerce as ex officio members. On matters involving highway locations, the Secretary of Defense would also serve as an ex officio member. The Commissioner of the Bureau of Public Roads would serve as Executive Director. The board of the Corporation should be responsible for the development of financial policy. It should serve when necessary as an appeals board to resolve major points of difference between the federal and state authorities which may arise under the program.

7. Toll roads built to acceptable standards and meeting other requirements of the Corporation may be included as segments of the Interstate System. However, toll financing is not a satisfactory solution to the full problem of network modernization.

8. Appropriate credit should be given to those states in which adequate sections of the Interstate System have been constructed by state or toll financing provided the funds thus made available are used for further highway improvements. Moreover, states that elect to build further toll-road sections of the Interstate System should be reimbursed for all costs other than financing, provided such funds are used for further highway improvement. Obviously, these funds would become available only after all other federal funds had been matched as required by law.

9. It is recommended that traditional federal-aid to the states be continued in the amounts authorized by the Congress in 1954 with some adjustments in the amounts for urban areas, and federal-domain roads, omitting the Interstate System authorization since this system is provided for in Sections 4, and 5 above.

10. In many states the modernization of highway enabling laws is necessary, especially in connection with the acquisition of land for right-of-way, the control of access, and the closer integration of state, city, and county highway managements. States should be encouraged to revise existing statutes where needed to permit expeditious and economical completion of the program. Congress should provide for the use of the federal right of eminent domain to acquire right-of-way for the interstate system where it is not feasible to obtain it through normal procedures under state law, and the state so requests.

most essential urban arterial connections—at an annual average cost of $2.5 billion for the 10-year period.

2. That federal contributions to primary and secondary road systems be continued at the rates authorized by the 1954 Act—approximately $525 million annually.

3. That federal funds continue to be made available at approximately the present rate of expenditure for those portions of the federal-aid Primary and Secondary Systems in urban areas not on the Interstate System—approximately $75 million annually.

4. That federal funds for Forest Highways be continued, at the present $22.5 million-per-year rate. Funds for improvement of the other public-land roads within the public domain should be contained in the budgets of the federal agencies responsible for the administration of these lands as mentioned above, but with the funds themselves transferred to the Bureau of Public Roads for expenditure as is done at present. These funds presently are at the rate of $58.5 million annually.

State and local participation

The Committee is of the view that the traditional requirement for local financial participation is sound and should continue. It was pleased to find that the Governors' Conference was of the same view. The Committee recommends no change in the matching requirements as presently fixed except for the Interstate System and the connecting routes included in the $27 billion program. In the accelerated program, the states would be expected to contribute annually the amount they are required to contribute now to obtain funds from the $175 million made available to the Interstate System by the Federal Government. The cities would be expected to participate to the same degree. This would make the cost of the 10-year program to the Federal Government about $25 billion.

Purchase of equity interest in existing roads

Some states have already constructed sections of the Interstate System to the required standards with either state or toll financing, and others are proceeding along similar lines. Such construction should not be discouraged by this report since our goal is maximum highway improvement. Those states in which sections of the Interstate System have been provided to meet the presently established standards for the completed system should receive appropriate credit, provided such funds are used to improve other roads on established federal-aid systems, or as may be approved by

the Federal Government, and all other federal funds for highway purposes have been matched as required. No funds should be made available as a credit for toll roads unless the returns from tolls above financing requirements are used exclusively for road construction as contemplated above.

To limit the federal liability, credit for roads built between 1947 and 1951 should be limited not only to those sections fully meeting the new standards but also to a maximum of 40 percent of costs other than financing. The credit for those roads completed prior to the calendar year 1955 should be limited to 70 percent of such costs. In no instance would credit be given for federal funds expended on the road or for toll roads, in excess of remaining amortization. Roads built at a later date should be credited at full cost.

The funds thus made available to the states will not only encourage matching of available funds but will also make possible accelerated improvement of primary, secondary and other roads, and will encourage local financing of interstate mileage to make funds available for other roads without increasing total federal responsibility. They will be paid to the states only as required to meet the costs of projects approved for construction and, it thus appears, would provide a major incentive to the highway improvement program as a whole. Table I shows the recommended financing of the proposed ten-year national highway program.

A federal highway corporation

The Committee finds it feasible to finance the needed improvements on the interstate network through a capitalization of appropriated funds in accordance with accepted financial principles, creating for this purpose a Federal Highway Corporation as an independent agency of the Government.

In the expenditure of funds provided for the Interstate System, the Committee recommends that Congress provide legislation to guide the Corporation in allocating such funds in a manner which would reflect the needs of the system in the respective states as jointly determined by the Commissioner of Public Roads and the states, and finally certified by the Commissioner of Public Roads.

To accomplish its purposes, the Federal Highway Corporation should be empowered by the Congress among other things to issue bonds and utilize the proceeds therefrom for the following purposes:

1. For payments by the Corporation to the states of the cost of constructing projects on the Interstate System and approved arterial connecting routes in urban areas; or payments of the cost of such projects undertaken by the Federal Government in the federal domain;

2. To establish an appropriate credit to a state which has built subsequent to the date of designation of the Interstate System or does build within the period 1955–1964 with state funds, or funds of an agency under state highway department control, sections of the Interstate System, toll or non-toll, in conformance with the prescribed design standards and other requirements which may be established by the Congress and the Corporation;

3. For necessary costs of administration, research, planning, and other purposes as authorized by the Congress;

4. To establish an Advance Revolving Fund, if requested by any state highway department, to enable it to prosecute the program pending receipt of any payments described above.

Consideration might be given to authorizing the Corporation, at the request of a state, to receive funds to be made available annually by the state to extend its bond issue, thus capitalizing for the state its proposed annual expenditures on the Interstate System. This might be helpful in those states with income insufficient to meet their matching requirements. It would require agreement as to rate of interest, security, and charges made by the Corporation for this service. Such agreement should be made only with the approval of the Treasury, and then only if possible without affecting the marketability and cost of the bond issue.

Bond issues

The Corporation should be authorized to issue bonds, in an amount sufficient to meet its share of the costs to complete the Interstate System during a construction period of ten years, with maturity schedules, interest rates and other conditions determined by the Corporation with the approval of the Secretary of the Treasury. Similar authority would extend to issuance of other bonds under one of the state participating proposals referred to above. The bonds would be fully taxable.

The obligations of the Federal Highway Corporation issued for Interstate System improvements should be secured by a contract between the Corporation and the Treasury Department under the terms of which it should be provided that the Corporation will receive certain specified amounts annually as authorized by the Congress, always sufficient to meet its obligations. It is estimated that these amounts, plus those proposed herein for continued allocations to the other federal-aid highway programs, will be approximately equivalent to that portion of the receipts from federal taxes on gasoline and lubricating oils.

These and other moneys received by the Corporation would be pledged in the first instance for payment of the interest and principal on any obligations issued by the Corporation. All balances remaining after the payment of debt service would be used solely, apart from setting up such operating reserve as may seem desirable, for improving the Interstate Highway System, the approved urban feeders, and other purposes described above.

The Corporation should have a mandatory call on the U. S. Treasury for loans up to some agreed total, possibly $5 billion outstanding at any given time, in order to assure investors of ability to meet obligations when due through borrowing temporarily from the Treasury, if ever necessary.

In order to broaden the market for the bonds of the Corporation, the enabling act should permit commercial banks to underwrite and deal in its securities in the same manner as those of the farm credit agencies and the International Bank for Reconstruction and Development. This would provide the widest possible trading as well as investment interest.

TABLE I. Proposed 10-year National Highway Program financing, in billions

System	Estimated 10-year needs			Proposed Financial Responsibility			
	Rural	Urban	Total	Fed. Highway Corp.	Regular fed. aid	State & local gov'ts	Totals
Interstate {existing	$12	$11	$23	$22	...	$ 1.00	$ 23.00
Interstate {extended	..	4	4	3	...	1.00	4.00
Federal-Aid Primary	20	10	30	..	$3.15	25.88*	29.03
Federal-Aid Secondary	15	..	15	..	2.10	12.90	15.00
Federal-Aid Urban	(Included above)			..	0.75	Incl. in Fed.-Aid Primary	0.75
Forest Highways	(Included above)			..	0.23	...	0.23
Subtotal, fed. systems	$47	$25	$ 72	$25	$6.23	$40.77	$ 72.00
Other rural roads	17	..	17	..	...	17.00	17.00
Other city streets	..	12	12	..	...	12.00	12.00
Total of all systems	$64	$37	$101	$25	$6.23	$69.77	$101.00

*Reduced by 0.75 billion and 0.23 billion taken up by Federal-Aid Urban and Forest Highway Funds.

Second article in a series sponsored by the Committee on Research of ASCE Hydraulics Division

FLOW IN POROUS MEDIA STUDIED BY HELE-SHAW CHANNEL

DAVID K. TODD, J.M. ASCE, Assistant Professor of Civil Engineering, University of California, Berkeley, Calif.

Both research and student demonstration purposes are served by the Hele-Shaw viscous-fluid channel in the Fluid Mechanics Laboratory of the University of California, Berkeley. The channel takes its name from Prof. H. S. Hele-Shaw of Liverpool, England, who more than fifty years ago built a similar apparatus to demonstrate to his students streamline flow patterns around boundaries of various shapes. If two plates are spaced only a small distance apart, fluid flow between them is laminar, and hence forms a two-dimensional potential flow field. Since flow in porous media also represents a potential flow field, in accordance with Darcy's law that the velocity is proportional to the slope, the channel can be employed as a model analogy of flow in porous media.

The model has the advantage of enabling accurate measurements of porous-media flow to be made without encountering the difficulties of a porous media. The free surface is clearly visible; a variable zone of partial saturation above the free surface is replaced by a calculable capillary zone; variable porosities and permeabilities are avoided; and velocities can be measured directly by dyes or volumetric discharge. Also, the free surface for steady flows can be scaled directly without resorting to piezometers, and motion pictures can be used to record unsteady flows.

To construct the model, two pieces of $\frac{1}{2}$-in. plate glass, 10 ft × 18 in., spaced about $\frac{1}{16}$ in. apart, are used. The spacing is maintained by aluminum strips wrapped in fiber sheet packing and fastened with C-clamps along the top of the channel, and with thumb screws along the bottom. The base support is built from cold-rolled steel bars which are bolted to a wooden base. A regulating reservoir of sheet iron is attached to the channel at one end, sealed with compressed neoprene tubing, and equipped with a slotted vertical slide gate which can be used to control unsteady flows into and out of the channel.

Fluid levels in the reservoir are maintained by inflow and outflow valves and are recorded by a Stevens water-level recorder. At the other end of the channel, another reservoir can be attached. The channel can be completely sealed, or an overflow lip can be attached at constant height. A clear mineral oil has proved very satisfactory for the fluid. A schematic diagram of the apparatus, Fig. 1, shows the fluid circuit setup.

An excellent student experiment consists of measurement and analysis of a steady flow in the channel. An overflow pipe is fixed in the inflow reservoir to maintain a constant head, while the overflow lip controls the outflow level. Students measure the flow rate volumetrically at the outflow lip, the temperature (to compute the density and viscosity of the oil), and the height of the free surface at intervals along the channel. They are then asked: (1) to plot the free-surface curve; (2) to compute and plot the corresponding free surface for steady undirectional flow using the Dupuit equation; (3) to compare the two curves and explain any discrepancies; and (4) to compute an equivalent permeability for specified scale ratios. The last requirement involves equating the known velocity scale ratio to the ratio of the steady-flow velocity of the model (given for viscous flow between parallel boundaries in any hydrodynamics text) to the prototype Darcy velocity, and solving for the permeability.

This channel is a versatile tool for research work. Unsteady sudden releases can be measured by use of the slide gate; sinusoidal fluctuations can be maintained in the regulating reservoirs; and various ground-water flow problems can be investigated by the model analogy, both for uniform and variable permeabilities (the latter by varying the spacing with thin laminated sheets attached to the glass plates). Two-fluid problems, such as sea-water intrusion underground and flow in petroleum reservoirs, can be investigated. With the addition of proper boundaries, seepage through earth dams and subdrainage problems can also be studied. The plate spacing and the fluid can be varied as needed to cover a wide range of flow conditions. Scale ratios may be selected to make the model analogy similar to many prototype conditions.

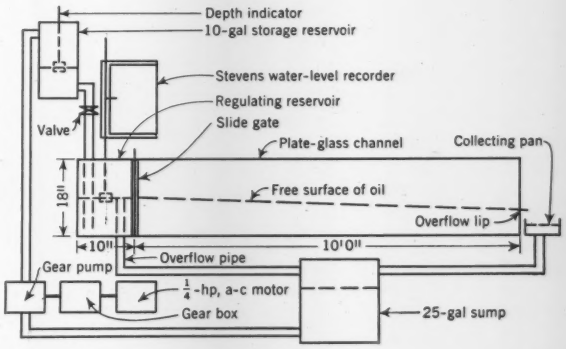
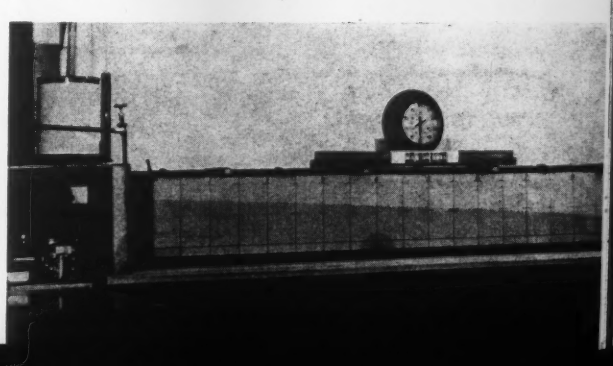


FIG. 1. Schematic diagram of Hele-Shaw channel indicates fluid flow circuit.



Steady flow of oil in the channel presents a well-defined free surface which can be measured directly by means of background grid.

Principal transport helicopter now in commercial use is Sikorsky S-55, single-engine, 10-passenger machine.

URBAN HELIPORTS are on the way

ROBERT HORONJEFF, A.M. ASCE

Lecturer and Research Engineer, Institute of Transportation and Traffic Engineering
University of California, Berkeley

HOWARD S. LAPIN

Research Associate, Institute for Urban Studies
University of Pennsylvania, Philadelphia

Growth of helicopter transport is making the provision of ground facilities a matter of increasing importance to city officials and airport operators. Space—whether on the ground or on the roof of a building—comes at a premium in an urban area. Careful planning must go into the selection of space for a heliport. Among other things, the operating characteristics of helicopters must be taken into account, the surroundings must provide suitable clearance, and the area must not be too sensitive to noise. To help provide a basis for such planning, an attempt has been made to assemble pertinent information from operating experience to date. Because experience with helicopters in urban areas is rather limited, no attempt is made to propose standards. Prevailing opinion, with which the authors agree, is that to propose standards at this time would be premature.

Helicopter transport growing

Four scheduled helicopter carriers are currently providing service in the United States, and two are providing service in Europe. In this country, helicopter mail service is provided in the metropolitan areas of Chicago, Los Angeles, and New York; helicopter passenger service, in the metropolitan areas of New York and Miami; and helicopter express service, in the metropolitan areas of New York, Miami, and Los Angeles.

The feeling of aircraft operators about the future of helicopter service is indicated by a forecast of the Air Transport Association, the industry association of air carriers in the United States. The ATA has forecast that, in the United States, domestic helicopter passengers will account for about 11 percent of all scheduled air passengers by 1960, and 24 percent by 1970, or 6 million and 22 million passengers per year respectively.

Helicopter transport in the United States began with mail service in the Los Angeles metropolitan area in 1947. This initiated a period of experiment and development which is still going on. The craft now in civil use are all single-engine, single-rotor helicopters with speeds on the order of 90 mph and a maximum capacity of 10 passengers. The present stage of development appears to be something like that of airline service in the late 1920's, when mail was the principal item carried and passengers were few.

It seems likely that another stage of helicopter development will begin about 1956, when larger helicopters become available for commercial use. The design of the initial models can be fore-

cast from craft now being tested, or now being produced for military use. These craft have two engines, speeds of about 140 mph, ranges of 200 to 300 miles, and capacities as high as 48 passengers. The effect of these craft on airline operations may well be like that of multi-engine fixed-wing aircraft some 20 years ago.

The next stage of development, while somewhat more speculative, seems likely to begin around 1960, with the introduction of compound helicopters having speeds of 200 mph or more. What these may require in the way of ground facilities cannot be forecast with any degree of reliability at present.

In summary, it seems likely that the use of single-engine helicopters will continue, but that facilities for two-engine craft will be required in the near future. On the other hand, new designs which will be forthcoming in the next few years indicate even now a need for flexibility in planning ground facilities.

The types of service that helicopters can render appear at present to include:

1. Inter-city operations up to 300 miles
2. Service from a city center to an airport in a large metropolitan area
3. Suburban service in large metropolitan areas, including commuter service
4. Connecting service between airports in the same metropolitan area

Helicopter characteristics affect heliport design

The distinctive characteristic of a helicopter is its ability to hover through application of power to the rotating airfoils. The practical consequences of this characteristic are a much greater range of flight speeds and flight attitudes than is the case with conventional aircraft, and the ability to land on and take off from comparatively small areas. Compound helicopters retain these features but by means of their conventional propellers can be made to fly at greater speeds.

Transport helicopters now in production or development have one or two rotors and in either case one or two engines—four combinations in all. The larger types now in production have two engines. This not only provides extra power for take-off but also guarantees greater reliability and safety, particularly in urban operations where landings must be confined to limited areas. The dimensions and other characteristics of transport helicopters are summarized in Table I.

The gross weights of the helicopters listed in the table vary from about 2 to over 20 tons. Transport helicopters have either tricycle or quadricycle landing gears. The weight of the craft is distributed on two main wheels and on one or two other wheels, which may be forward or aft of the main wheels. The greater load is carried by the main wheels. Several transport helicopters are shown in the accompanying photographs.

While helicopters can ascend vertically from the ground, vertical ascents, except for the first few feet from the ground, severely restrict the load-carrying capacities of current models. The usual procedure is to employ vertical ascent (about 6 ft) only to initiate the take-off, then to proceed in a horizontal direction in a slightly ascending path until climbing speed is achieved, after which the climb-out is made. For some of the current models the best speed for climb-out is between 40 and 50 mph.

From a safety standpoint, the operation of single-engine helicopters from city centers requires that emergency landing be possible from any point in the flight path. In case of engine failure, a safe landing utilizing autorotation can be made if space is available. Autorotation means the continuation of rotor rotation in flight without power.

Two-engine helicopters, on the other hand, are being designed to permit continuation of flight and even a moderate rate of climb after one engine has failed. For these craft it will therefore be unnecessary from a safety standpoint to have space available for emergency landing along the entire flight route.

Approach-path requirements

Although the helicopter is capable of vertical ascent and descent, such performance is not acceptable for economical everyday operation, as has already been discussed. Provision must be made for gradual ascents, and this means that an obstruction-clearance plane must be established from the edge of the landing pad to the altitude of level flight.

The required obstruction-clearance angle will be determined both by the take-off procedure and the performance characteristics of the aircraft in use. For the immediate future, it appears that the slope of the obstruction-clearance plane will have to be limited by the capabilities of the twin-engine helicopter with one engine not operating. The slope will be established on the performance at take-off rather than landing since a descent can be made safely at much steeper angles.

Operational experience in take-offs will have to be gained before standards for obstruction clearance planes can be firmly established. In the meantime the helicopter manufacturers have indicated that a probable obstruction-slope requirement in the direction of take-off would probably be in the neighborhood of 15 deg (1 in 4) for the first 400 ft from the edge of the landing pad, then 25 deg (1 in 2) out to 1,000 ft. At the heliport, the width of the obstruction-clearance plane might be at least equal to the width of the heliport, and might gradually widen to a minimum of 500 ft in a horizontal distance of approximately

TABLE I. Transport helicopter characteristics*

Manufacturer and Model No.	Passenger Capacity	No. of Engines	No. of Rotors	Rotor Dia., ft	Max. Dimension, ft	Gross Weight, lb	Max. Wheel Load, lb	Tire Pressure, psi	Status
Helicopters:									
Sikorsky S-51	3	1	1	49	57.7	5,300	1,875	45	In service
Bell 48	8	1	1	47.5	58.8	7,200	...	..	In service
Sikorsky S-55	10	1	1	53	63	7,200	2,100	55	In service
Bristol 173†	13	2	2	48.5	89	10,600	...	..	In development
Bell 61	15	1	2	..	..	16,000	...	..	In development
Piasecki PD-22	11–20	1	2	44	86.3	12,900	...	..	In development
Percival P-86†	40	1	1	..	..	30,000	...	..	In development
Hiller H-40	40	..	..	..	..	...	...	..	In development
Piasecki H-16	48	2	2	82	134	40,000+	16,000	100	In test
Sikorsky S-56	38	2	1	90	..	28,500	...	..	In service‡
Compound Helicopters:									
Gyrodyne	24	1	2	..	..	...	...	..	In development
Gyrodyne	50	2	2	..	..	...	...	..	In development
Fairey†	36	..	2	..	..	30,000	...	..	In development

* Compiled from manufacturers' specifications, technical publications, and Jane's *All the World's Aircraft, 1952–1953.*
† British.
‡ Military only.

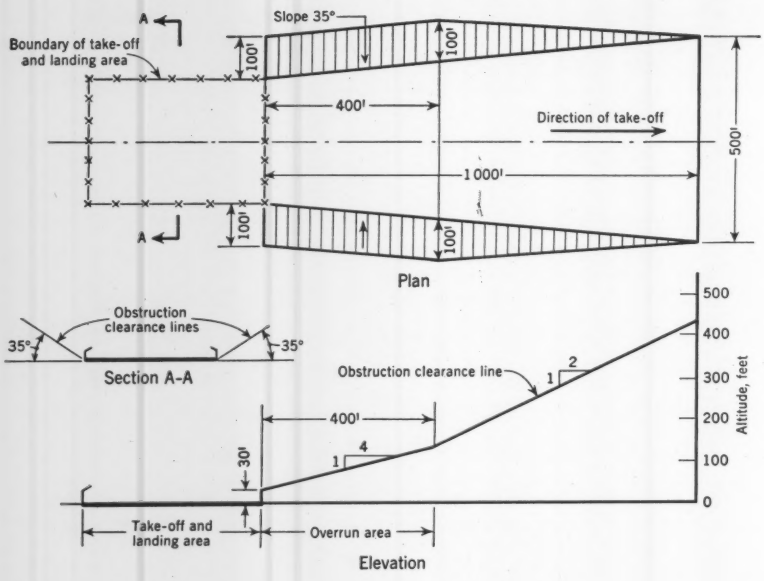


FIG. 1. Proposed obstruction-clearance planes for an urban ground heliport are shown in plan and elevation.

1,000 ft. Side clearance might be on the order of 35 deg from the edge of the heliport. These proposals are shown in Fig. 1.

In selecting routes over urban areas, the primary considerations are maximum safety and minimum nuisance. Safety is mainly a matter of having clear flight paths with access to obstruction-free landing areas, as previously discussed. Nuisance is mainly a matter of noise.

Typical routes which often meet the primary requirements are over canals, rivers, and railroads. The noise caused by helicopter operations within or adjacent to built-up urban areas is and will continue to be an extremely important factor in planning for helicopter transport, even though manufacturers are aware of the problem and are studying ways in which noise can be minimized. If at all possible, the landing pad should be so oriented that take-offs and landings are made over areas where noise would be least objectionable.

Heliport dimensions

Overall dimensions of a heliport depend primarily on the physical dimensions of the craft to be served, on their performance characteristics in take-off and landing, on the volume of traffic, and on the rapidity with which take-offs and landings can be made in unfavorable weather. The size of the landing and take-off area will depend primarily on the performance characteristics of the craft using the heliport and the techniques used in take-off and landing.

It has been suggested that the way to attack the problem is to determine the size of heliport that is practical and economically feasible in a city center and then build the necessary performance into the helicopter to enable it to operate from this area. This suggestion has merit; unless the heliport can be kept within reasonable dimensions it will have to be located in a suburban area just as an airport is.

For the single-engine helicopters currently in commercial use, such as the S-55, a take-off and landing area approximately 200 to 250 ft square will suffice. The approach and take-off paths must be relatively clear of obstructions to permit emergency landing beyond the boundary of the heliport.

For twin-engine helicopters, it is felt that a forward take-off should be coupled with the requirement that the take-off area be at least long enough to insure the attainment, within its boundaries, of climb-out speed with one engine inoperative. In addition to this requirement, it is considered by some, particularly in the period of development of multi-engine craft, that there should be an overrun strip to provide for such an emergency as engine failure before the attainment of climb-out speed with one engine inoperative. Descent forward of the point of take-off is necessary if engine failure occurs before climb-out speed is achieved. This concept is depicted in Fig. 2. A take-off and landing pad 250 to 300 ft wide by 400 to 450 ft long, and a cleared overrun strip varying in length from as much as 400 ft to a fraction of this distance, depending on the operational limitations of the craft, have been suggested for the present while experience is being gained in landing and take-off techniques. The pavement on the overrun strip need not have the same strength as the main take-off and landing area.

Effect of cross winds

A cross wind is defined as the wind component at right angles to the path of the helicopter. For fixed-wing transport aircraft, a cross wind up to 20 mph is generally considered not too bothersome. Helicopters can maneuver in cross winds much higher than fixed-wing aircraft, so the orientation of a rectangular landing pad into the wind for helicopters is not nearly as important as is the orientation of runways for conventional aircraft. Nevertheless, it is desirable to orient the axis of the landing pad in the direction of take-off and landing as nearly into the wind as possible. In many localities, the final decision in orienting the landing pad will be based on a compromise between the direction of an obstacle-free approach path and the principal wind direction. At present, it appears that the cross-wind characteristics of the helicopter will be such as to permit the building of heliports with only one direction of approach. Adverse wind currents can be created by objects adjoining the take-off and landing area. This matter deserves careful consideration in the layout of a heliport.

The dimensions so far discussed are those required for landing and take-off only. Depending on the volume of traffic, additional space is required for other functions, such as parking of heli-

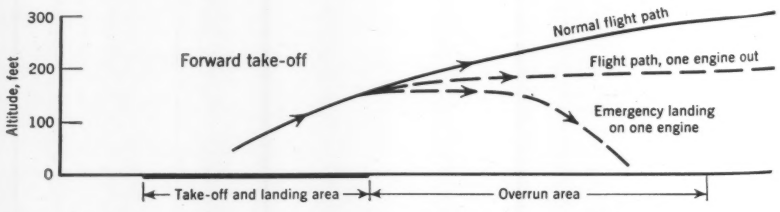


FIG. 2. Flight paths for helicopters at take-off are diagrammed, including emergency landing on one engine.

copters for loading and unloading, facilities for passenger accommodations, and adjacent automobile parking space.

At heliports where the volume of traffic is relatively small, loading and unloading of passengers can be accomplished on the landing pad, so that it will not be necessary to provide additional space for this operation. As traffic increases it will be necessary to provide additional space. As an initial guide in planning, it can be assumed that it will take no more than 10 minutes at the maximum to load and unload a helicopter of 20- to 30-passenger capacity, to refuel it, and to perform routine inspection. In most cases the en route stops will be of durations shorter than 10 minutes.

It is generally desirable even at small heliports to provide, whenever possible, some parking space so that an unserviceable machine can be removed from the landing pad. The amount of parking space for an individual helicopter will depend to a large extent on the overall dimensions of the machine, and whether or not folding rotor blades will come into general use. At present, only a few transport helicopters are equipped with folding blades.

Structural design of heliports

Normally a ground heliport will have to be surfaced with some kind of paving material. The nature of the surfacing will depend a great deal on the weight of the helicopter, the frequency at which the load is applied, the magnitude of impact on the surface at touchdown, and the character of the native soil at the site. The pavement may consist of either portland cement concrete or bituminous concrete, depending on which is the most economical.

A helicopter's main landing gear is customarily designed to withstand a load from 3 to 4 times the normal weight carried by the gear, although in landing it is expected that the applied load on the pavement surface will not be greater than 1.5 times the load on the gear. A pavement failure caused by a hard landing would not be as critical at a ground heliport as on a roof top. Furthermore, repairing a pavement would, under normal circumstances, be considerably cheaper than repairing a roof. Consequently, the factor of safety for pavement design need not be as large as the corresponding factor for roofs. For the pavement of a ground heliport, a static load of 1.2 times the weight of the aircraft is suggested as an initial guide in planning. In other words, if the static load of each wheel of the main landing gear of a helicopter is 5,000 lb, then the load used for the design of the pavement should be on the order of 6,000 lb, which provides for 20-percent impact.

So far no method of analysis has been developed specifically for determining the thickness of a bituminous or portland-cement-concrete pavement for helicopter traffic. Design procedures for highway and airport pavements should be applicable with fair reliability to the design of heliports.

Roof facilities have proved generally satisfactory where they have been made available for helicopter operations. Helicopters have been flown from heliports atop buildings in Los Angeles, Chicago, and New York. The recently completed air lines terminal in New York was designed to provide for helicopters on the roof.

Roof heliports present several operational advantages. The possibilities for locating a heliport close to the center of activities in a city are generally enhanced by the use of roof areas. Another important point is that the land cost is partially absorbed by the tenancy of the lower floors of the building. A third factor is the shortened climb-out over possible obstacles and up to flight altitude. In future years, as helicopter transport gains in volume, the possibilities for compact arrangements combining passenger waiting rooms, auto parking areas, and facilities for the flight and ground operations of helicopters will be compelling reasons, along with the others mentioned, for the construction of special buildings for urban helicopter operations.

Two factors concerned with weather might be mentioned in connection with roof facilities. Further information is required concerning the effects of high, gusty winds. Possible turbulence over the roof surface, and downdrafts near buildings present obstacles to safe operations. Another weather problem—especially significant for higher structures—is reduced visibility caused by a low ceiling, a factor that might decrease the usability of an elevated heliport.

Manufacturers have indicated that, in the years foreseeable, the largest helicopters in commercial service may have gross weights ranging up to 45,000 or 50,000 lb. However, 30,0000 lb has been suggested as the maximum for roof facilities for some time to come. It should be pointed out that a great amount of helicopter transport will undoubtedly be provided by craft ranging in weight from 7,200 lb (the S-55) to 15,000 or 20,000 lb. Therefore it may not be necessary to design for a 30,000-lb load, especially where strengthening of an existing roof is concerned.

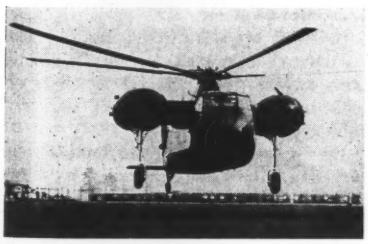
Sikorsky Aircraft has suggested that a roof would have sufficient strength if no part of it were stressed to more than the permissible working stresses, when carrying a concentrated load acting on any one square foot, equivalent to three-quarters of the gross weight of the helicopters in the case of aircraft with tricycle-type landing gear, and two-thirds of the gross weight in the case of quadricycle-type landing gear.

The area designed specifically for touchdown need not cover the entire roof area but might be as small as half of the rotor diameter in width and half of the maximum dimension of the craft in length. Thus an area of 40 × 60 ft may be sufficient for the touchdown portion of roof heliports.

Use of existing surfaces reduces costs

In general, the acquisition and development of heliports involve costs that can be readily estimated from experience with other types of facilities. In many instances, costs have been greatly reduced by utilizing existing surfaces, and the possibilities include shipping piers, roofs of buildings, and platforms over terminal buildings for other transportation.

Under test by U. S. Air Force, Piasecki H-16 represents current tandem-rotor, twin-engine experimentation. It carries 48 passengers.



Now in military use, the twin-engine 38-passenger Sikorsky S-56 may be in commercial transport service a few years hence.

SEATTLE TESTS NOVEL VENTILATION SYSTEM FOR VEHICULAR SUBWAY

H. WARD TYLER, A.M. ASCE, Principal Engineer, Department of Engineering, City of Seattle, Wash.

Before Seattle's Battery Street Vehicular Subway was opened, a test was made of the ventilation system, using 147 cars and 33 trucks in a simulated traffic jam. This system is a radical departure from the conventional type of tunnel ventilation with longitudinal ducts and large blower plants.

The ventilation system for the Battery Street Vehicular Subway consists of 72 individual intake fans uniformly spaced throughout each roadway of the 2,134-ft length of the subway [described by Ralph W. Finke in CIVIL ENGINEERING for December 1952]. Air is taken from the sidewalk area of the surface street above and blown downward with sufficient velocity to spread out over the floor of the subway, where it mixes with the exhaust gases from motor vehicles. Contaminated air is driven out through exhaust vents located in the ceiling along the center wall separating the two roadways, as well as through the ends of the subway.

Each fan has a capacity of 15,500 cfm, which provides a total air intake equal to the volume of the air in the subway in less than 2 minutes. Fans are automatically actuated from a central control chamber, in eight sections of nine fans each, by carbon monoxide analyzers. These analyzers, furnished by the Mine Safety Appliances Company, draw in continuous samples of air from eight separate pickup points. When the analyzers show a concentration of 0.015 percent of carbon monoxide, or 150 parts per million (ppm), the nine fans in that section are automatically turned on and remain on for 1 min, or until the carbon monoxide content drops below this amount. If the carbon monoxide content of the air continues to rise, at 0.03 percent all 36 fans in that roadway are actuated and operate for 2 min, or as long as the carbon monoxide content is above 0.03 percent at any point.

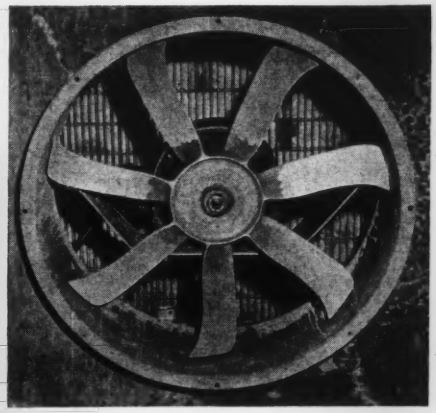
Artificial traffic jam created

The test, which was run a week before the subway was opened, consisted of assembling enough cars and trucks to fill both lanes of one roadway. At a predetermined time all motors were turned on and run at idling speed for 30 min. During this period ten observers stationed at critical points took readings at 10-min intervals with portable colorimeters. Additional samples were taken in vacuum bottles furnished by the U. S. Bureau of Mines for laboratory analysis, and the fixed carbon monoxide analyzers also printed a record of the test from the four fixed pickup points. After the 30-min idling period, drivers were instructed in driving out to accelerate as rapidly as conditions would permit. Each observer took another air sample as the last vehicle passed him.

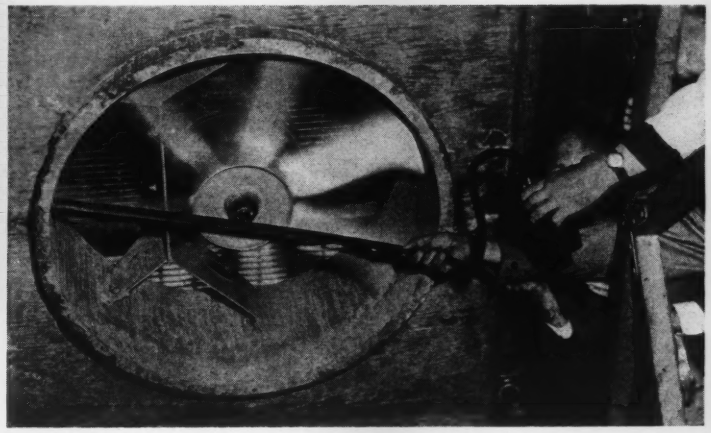
Results of the test, from samples observed at the time, showed an initial buildup of carbon monoxide which reached a maximum of 0.04 percent before the fans started. This was reduced immediately thereafter, becoming stabilized at 0.02 percent uniformly throughout the subway. The acceleration test failed to show any marked in-

← In test of ventilation system, one of two 25-ft tunnel roadways was filled with cars for its full length of 2,134 ft. In simulated traffic jam, all motors were idled for 30 minutes while tests were made of carbon monoxide content of air. Ventilation system held this content to 200 ppm.

Above: Air samples from eight pick-up points are automatically analyzed and recorded. Equipment is being switched on by P. C. Leonard, Resident Engineer of State Department of Highways.



Intake fan consists of cast aluminum hub and blade of 33-in. diameter, directly connected to 3-hp, totally enclosed motor. Each fan has discharge of 15,500 cfm at 1,150 rpm. Below, fan discharge is being checked with velometer.



crease in the contamination of the air. Initial buildup was due to the time lag required for the air samples to reach the central control chamber and pass through the analyzers before the fans were turned on.

Large saving realized

Construction costs of the complete ventilation system amounted to $130,000, which includes ventilation fans and motors and intake and exhaust gratings. The estimated cost of a comparable system using a central blower plant with intake and exhaust blowers, longitudinal air ducts and cross ventilation, was $700,000.

Under normal traffic conditions, the natural draft due to the pumping action of vehicles passing through the subway provides sufficient ventilation. When traffic is heavy, alternate fans are operated manually to control exhaust smoke and odors. Abnormal conditions causing slowing or stoppage of traffic will automatically start the remaining fans, if needed.

Some studies have also been made of the air contamination on the surface street due to the exhausting subway air. Readings taken directly over the exhaust gratings at breathing level during the subway ventilation test showed a carbon monoxide contamination of 0.005 percent, or 50 ppm. Other tests were made on the surface street during the design stage. These tests, taken during the worst possible conditions of temperature, wind velocity, and traffic conditions, also showed a contamination of 0.005 percent. Adding these results, it is believed that under the most adverse combination of conditions in the subway and on the surface street, the contamination of the surface air will never exceed 0.01 percent of carbon monoxide.

Good results in operation

Operating experience covering the first three weeks of operation has shown that the mechanical ventilation system is only needed during the peak evening hours from 4:30 to 6:00 p.m. Failure of the surface street to carry away the northbound traffic causes slowing and backup of traffic during the evening rush. Morning traffic on the southbound roadway is carried away freely, and the carbon monoxide content does not reach the critical point which would cause the fans to operate.

Design of the ventilation system and the subway was done by the Engineering Department of the City of Seattle under the supervision of the writer. Construction work was under the supervision of the State Department of Highways, with D. D. Forgey, M. ASCE, District Engineer, and P. C. Leonard, Resident Engineer, in immediate charge of construction. Testing of the ventilation system was done jointly through the cooperation of the U.S. Bureau of Mines, with L. H. McGuire, District Engineer; the State Department of Highways, with C. A. Pilon, A. M. ASCE, Assistant District Engineer; and the writer, of the Seattle Engineering Department.

Accompanying photos are by John Bossert, Seattle, Wash.

OGOCHI DAM

provides new water supply for Tokyo

Tokyo, Japan, the third largest city in the world. for some time has needed a major increase in its water supply. The Tama River is being harnessed to add another 112 mgd to the city's present Hamura system supplying 147 mgd. The building of Ogochi Dam, a straight gravity-type structure containing 1.99 million cu yd, will create a 152,000 acre-ft storage reservoir. Hamura intake on the Tama River, about 15 miles above Tokyo, supplies the Hamura system.

Early water supply system

Three hundred years ago, in 1654, the original plan for a water supply for Tokyo was initiated when the Tama River was tapped for domestic and irrigation purposes. As the city grew, other sources were progressively developed by tapping the Tama River, the Edo River, the Sagami River, and a system of wells located in and near the Tokyo area. Aqueducts, filtration plants, distribution systems and appurtenant facilities were progressively installed to provide for the ever growing needs of the city. See Fig. 1.

On July 11, 1932, after many years of careful planning, the project for constructing Ogochi Dam and Reservoir as an additional source of water supply was submitted to the Tokyo Metropolitan Assembly. Many problems, such as land use and irrigation rights, had to be resolved before final approval was secured for the project in July 1936.

The 1954 population of Tokyo is estimated at 6,080,000 and the per capita water consumption, at 91.2 gal per day. By 1960 a population of 7,200,000 is forecast, with a per capita consumption of 100 gal per day.

Tama River rises at the foot of Mt. Kastoria, 80 miles west of Tokyo. It runs eastward between mountains ranging up to 6,000 ft high, which are covered with virgin timber, and empties into Tokyo Bay. The water is noted for its clarity and purity. Owing to the topography of the upper reaches of the 500-sq mile drainage basin, the runoff immediately following rains is very heavy and rapid. Rainfall records for the 37 years prior to 1951 show an average precipitation of 68.1 in. per year, with the maximum (in 1938) being 102.5 in. and the minimum (in 1926), 40.8 in.

Runoff for the same period, measured at the Hamura Intake of the present system, ranged from a minimum of 96 cfs on June 3, 1940, to a maximum of 52,242 cfs on September 15, 1919. The mean annual discharge is 687 cfs, with 60 percent of the annual total, or an average of 1,237 cfs, discharging during the four high-water months of July, August, September, and October. It is estimated that 44 percent of this runoff now is wasted into Tokyo Bay.

A dam at the village of Ogochi, 30 miles west, or upstream, from Tokyo, would control the upper 100 sq miles of the Tama River basin. Preliminary operations were started in 1936. Buildings were removed, roads relocated, diversion channels and a tunnel constructed. A quarry was developed. After the dam site was excavated, the foundation was grouted, and construction railroads and roads were built. The concrete mixing plant and the concrete placing equipment were obtained and installed. Much of the latter was first used on the construction of Hoover Dam on the Colorado River by the Six Companies. This preliminary work continued until 1943 when, because of the war, operations were discontinued. The value of this preliminary work, based on present-day yen, is $12,800,000 (360 yen equals $1.00).

Multi-purpose development adopted

The original plan contemplated the construction of Ogochi Dam and its 152,000-acre-ft reservoir solely as an additional raw-water source for the Hamura system. When work on the dam was resumed in 1948, a complete restudy of the project was made. This led to the proposal that the development be made multi-purpose and include a new 112-mgd rapid-sand filter plant at Higashi-Murayama. See Fig. 1. To connect with the present system, 97,520 ft of semi-steel conduit, varying in diameter from 96 in. down to 24 in., will be required.

Four hydroelectric plants downstream from Ogochi Dam will generate a total of 68,000 kw for an annual total of 320 million kwhr. Water from the Ogochi Reservoir, after passing through the power plants, will be picked up from the river at the existing Hamura Intake, 15 miles below the dam. From the intake it will be conducted via the existing Hamura-Murayama conduit to the Yamaguchi and Murayama Reservoirs. After treatment at the proposed Higashi-Murayama filter plant to be built nearby, the water will be conducted in a 96-in. conduit to a connection with the existing distribution mains at Hongo 13 miles to the east. Thence in smaller conduits it will be conducted south to Chiyoda and north to Taito.

Other economic advantages of the Ogochi Project, vital to the welfare of this large metropolitan area, include water for fire protection, agriculture and industry. Another aim is the control of disastrous floods that now cause loss of life, plus crop and industrial damage amounting to millions of yen annually.

The estimated cost of completing the dam and reservoir, together with the Higashi-Murayama filter plant and distribution mains, is $27,400,000. To this must be added the cost of the four hydroelectric power stations, 37 miles of transmission lines, and substations, estimated to cost $19,400,000. The total cost of the project will be approximately $59,600,000.

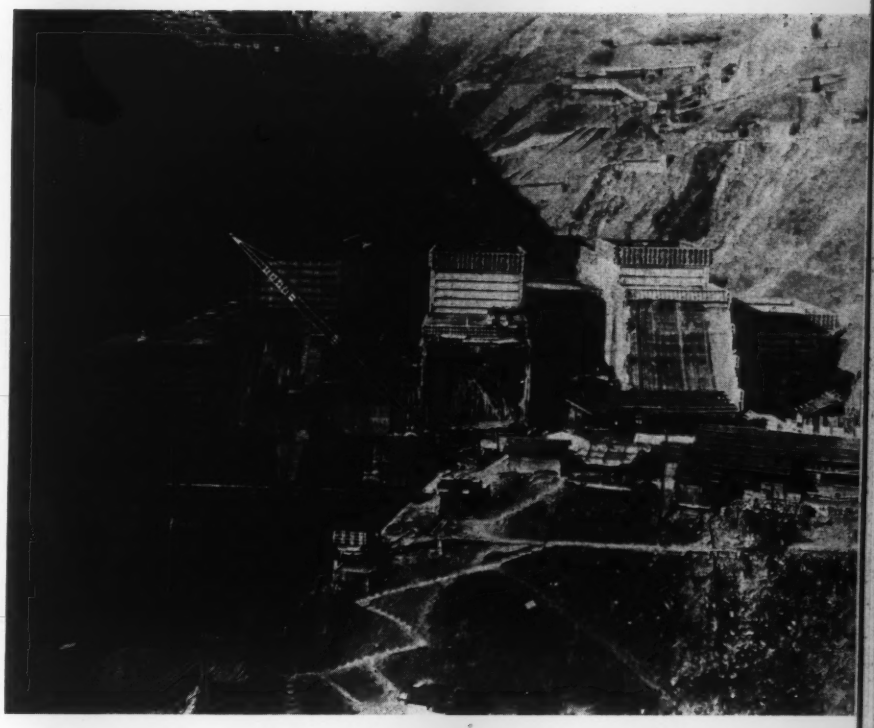
Since October 1950, when the first concrete was placed in the foundation of Ogochi Dam, steady progress has been made on that structure. Barring unforeseen construction difficulties and provided financing continues, the dam will be completed March 31, 1957.

Foundation conditions at the dam site are excellent. The exposed Jurassic graywacke, containing lens-shaped slate, is very hard and dense. It is considered suitable for the foundation of a high dam since no faults have been found. The dam (Fig. 2) is concrete, of the non-overflow, straight gravity type, 489 ft high above the lowest foundation elevation, and 1,132 ft long, with its crest at El. 1,739 ft. The maximum width at the bottom of the dam is 459 ft. It will contain 1,990,000 cu yd of concrete, and a 30-ft roadway will run along the crest.

Galleries for inspection, drainage and

MAURICE M. CLASS, M. ASCE

Consulting Engineer, Tokyo, Japan
Formerly Colonel, Corps of Engineers
Chief of Engineering and Construction
ESS, GHQ, SCAP



Progress view shows dam under construction on December 31, 1954. At this time, 607,000 cu yd of concrete had been placed, about 30 percent of total. Completion is scheduled for March 1957.

FIG. 1. Ogochi Dam on Tama River will add 112 mgd to domestic water supply of Tokyo. Multipurpose project includes irrigation, flood control, power, recreation.

grouting are provided at six levels. Access to these galleries will be by means of a vertical shaft with an elevator at the center of the dam. At four elevations, outlet conduits, capable of discharging 494 cfs from the reservoir to the Tama River, lead through the dam to a downstream water cushion structure.

A gated spillway channel around the left (north) abutment leads spill water to the head of Mizune Ravine, which discharges into the river about 300 ft below the dam. The spillway has a design capacity of 49,000 cfs.

Construction plant made in U.S.A.

Concrete for the dam is being mixed at a two-drum, 8-cu yd central mixing plant located on the left (north) bank of the canyon, about 1,000 ft above the dam. From the mixers a double-track concrete-transfer railroad of 42-in. gage transports 8-cu yd buckets to a point under the concrete-placing cableways (Figs. 3 and 4).

Two 25-ton cableways, a 5-ton cableway, and a 9-ton jib crane are disposed so as to place the concrete in all sections of the dam. A quarry for aggregate was opened about 2,000 ft above the dam. Here a 500-ton per hour crushing and screening plant manufacturers aggregate and delivers it by belt conveyors to the mixing plant. Cement for the work is delivered by construction railroad to Mizune Station, whence it is conveyed to two 750-ton silos at the mixing plant.

Officials of the Tokyo Government's metropolitan office responsible for the Tama River multi-purpose project are Yoshimitsu Tokuzen, Chief, Water Supply and Drainage Bureau in Tokyo;

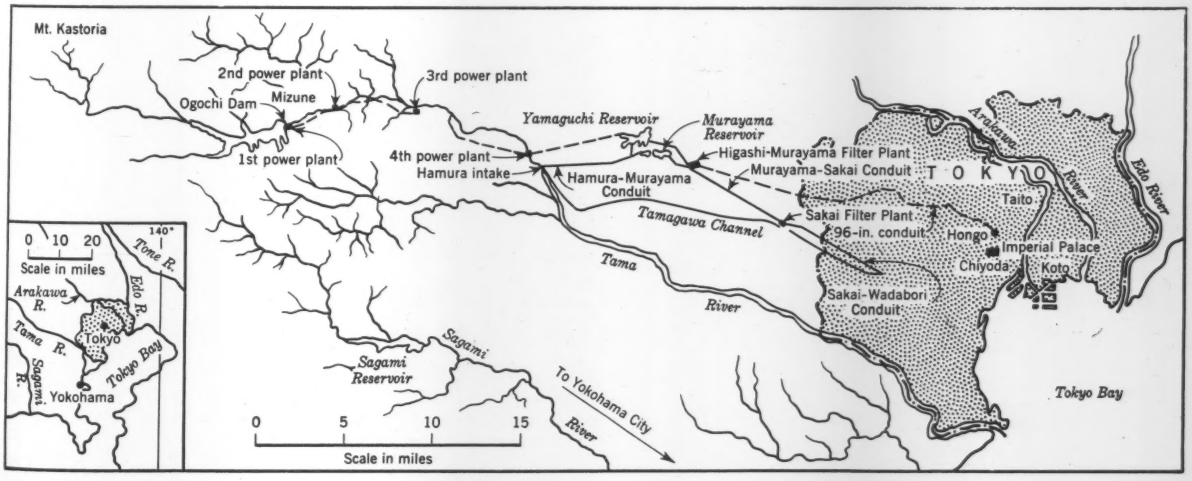


FIG. 2. In maximum section, Ogochi Dam is 489 ft high.

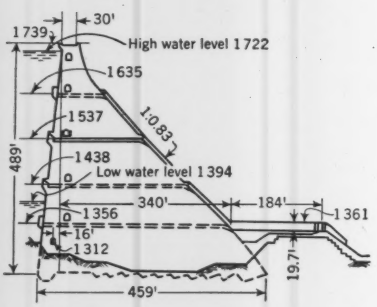


FIG. 4. Plan and elevation of Ogochi Dam show two 25-ton cableways, which will place bulk of 1,990,000 cu yd of concrete in structure. In downstream part of dam, beyond reach of main cableways, concrete will be placed by 5-ton cableway and 9-ton jib crane.

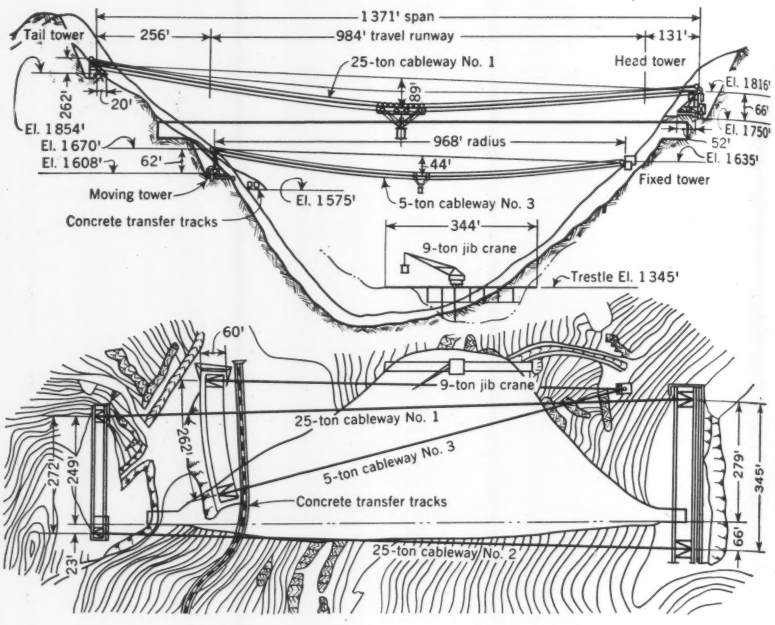
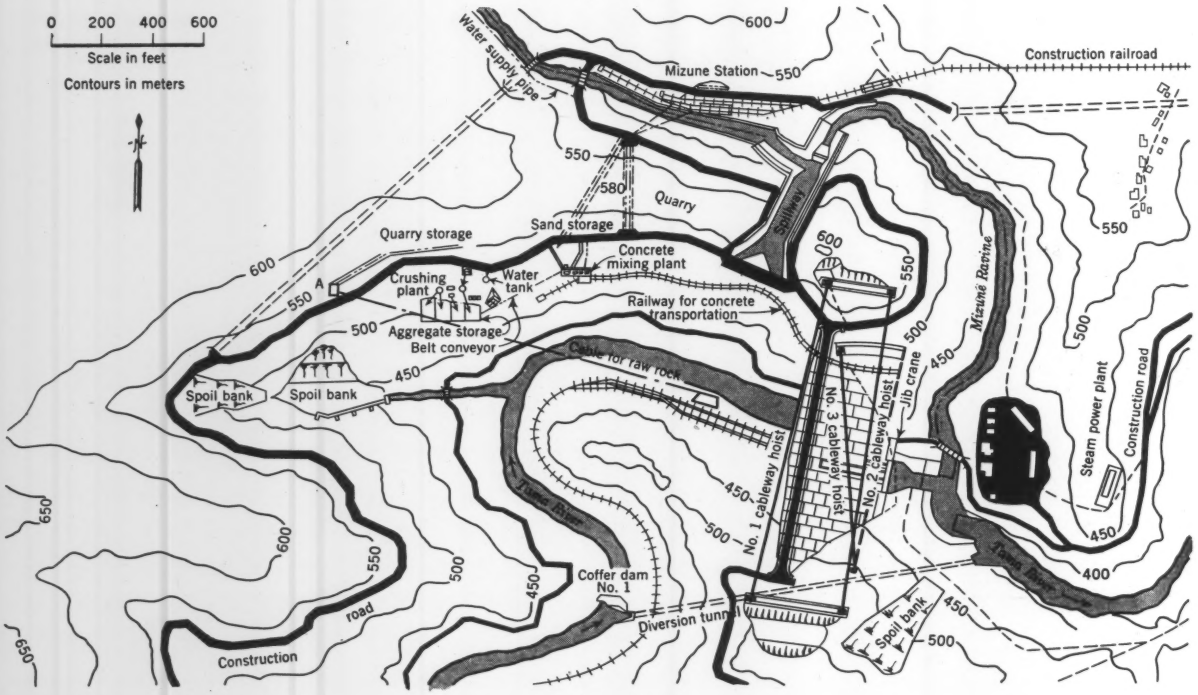
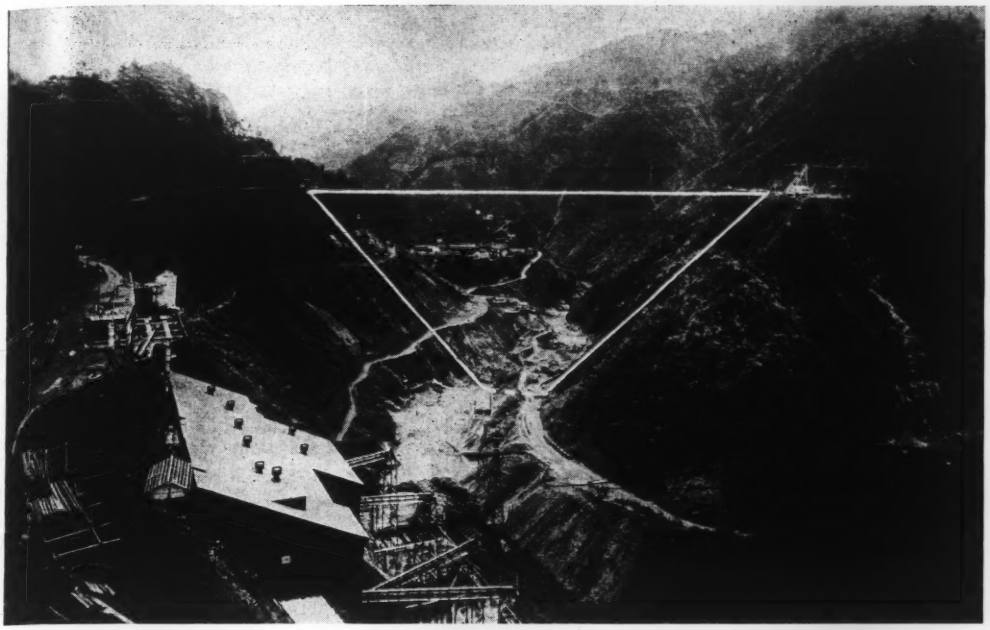


FIG. 3. Construction plant layout for Ogochi Dam includes Lidgerwood cableways for concrete placing, first used on Hoover Dam on Colorado River.

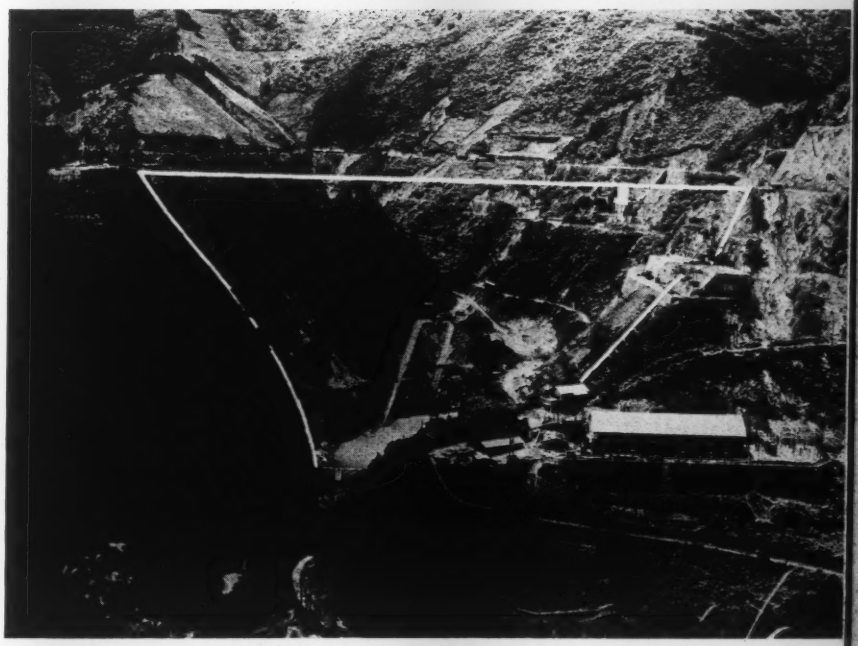




In view taken from top of rock hoist (point A in Fig. 3), looking downstream, crushing and screening plant is in foreground at left, and concrete plant is beyond.

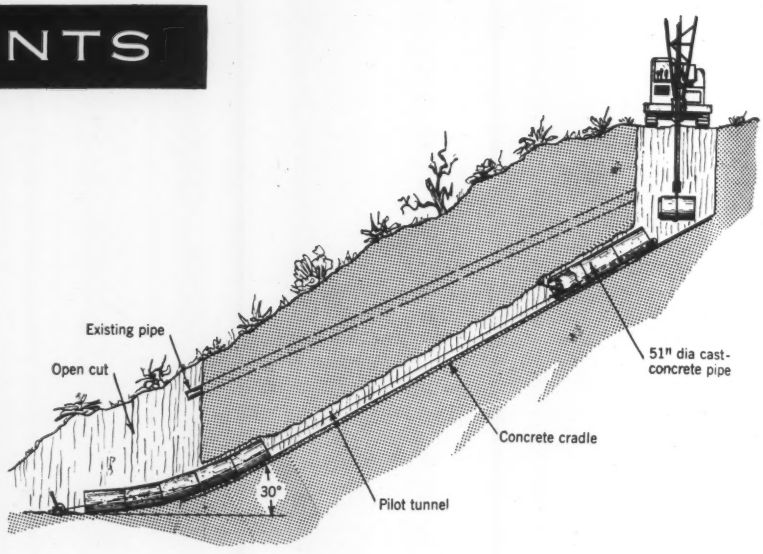
Shiro Sato, Chief of Construction at Ogochi Reservoir; and Motoki Ono, former designer, now consulting engineer of Tokyo. In 1951, J. L. Savage, Hon. M. ASCE, consulting dam engineer, visited the project site and since that time has taken continuous interest in the progress of the work. Design, construction, and procurement of materials are all being carried out by the forces of the Tokyo Metropolitan Government.

The design and construction of this project, which includes one of the world's great dams, demonstrates the high degree of technical skill that is in the possession of Japanese engineers and the Japanese heavy construction industry.



Construction site is seen from below dam, looking upstream, as it appeared in 1950 when first concrete was placed in foundation. Steam power house and engineers' field office are in foreground. Concrete-placing cableways are installed over dam site. Aggregate plant and concrete mixing plant appear at far right on upstream side of dam.

FIELD HINTS



Method of placing concrete pipe sections in pilot tunnel at top of slope relied on gravity, weight of pipe, and a come-along to move them down on previously prepared concrete cradle.

Drainage pipe moved into place down 30-deg inclined shaft

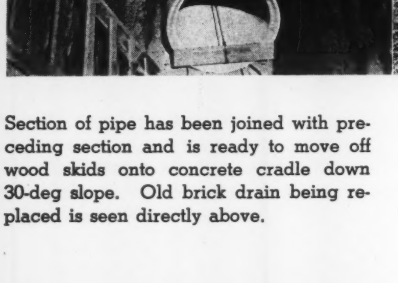
A 65-ft bluff was an obstacle that had to be overcome in order to place reinforced concrete pipe of 51-in. diameter for the 26th Street–Georgina Avenue drain in Santa Monica, Calif. This drain is a part of the Los Angeles County Flood Control Project No. 246.

Alternate methods of placing the drain called for either jacking or tunneling to lay the 51-in.-diameter, 8-ft-long sections of tongue-and-groove reinforced concrete pipe, on a 30-deg slope, down into Santa Monica Canyon at the end of 17th Street. The discharge end of the drain is about 175 ft from the base of the bluff.

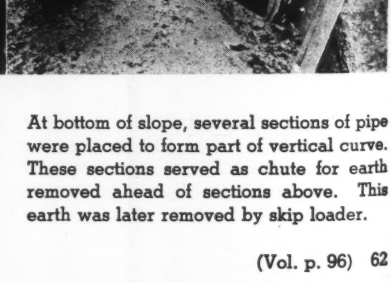
Charles Burch & Sons, contractor on the project, successfully used an unusual approach. The first step was to dig a shaft 24 ft deep at the top of the bluff. Then a pilot tunnel 3 to 4 ft in diameter was hand dug from both ends. A concrete cradle 24 to 30 in. wide and 6 in. deep was poured the length of the pilot tunnel, establishing line and grade.

After several sections of beveled pipe had been set in to form part of the vertical curve at the bottom, as shown in the accompanying sketch, the rest of the pipe was inserted from the top of the

With very little assistance from come-along, five sections of pipe move down slope in pilot tunnel as workman clears away excess dirt in front.



Section of pipe has been joined with preceding section and is ready to move off wood skids onto concrete cradle down 30-deg slope. Old brick drain being replaced is seen directly above.



At bottom of slope, several sections of pipe were placed to form part of vertical curve. These sections served as chute for earth removed ahead of sections above. This earth was later removed by skip loader.

bluff. When a section had been lowered into the shaft and lined up, gravity, the weight of the pipe, and the assistance of a come-along were sufficient to move the last section and those ahead of it down the tunnel. Excess earth was cleared away ahead of the front section and slid down the tunnel and out through the pipe at the bottom.

Grout was poured down the tunnel around the outside of the pipe and the joints were plastered inside. The vertical curve at the top was laid in open ditch.

Paul Rappe was superintendent on this part of the project, and H. Berkowitz was the Los Angeles County Flood Control inspector under the direction of Senior Inspector Harold Ball.

Project No. 246 is part of the over-all plan of the Los Angeles County Flood Control District under a $179,000,000 bond issue which was approved by the voters in November 1952.

The pipe, furnished by the United Concrete Pipe Corp., proved rugged and easy to handle. The methods adopted by Charles Burch & Sons for placing it solved the problem with a minimum of time and effort.

ENGINEERS' NOTEBOOK

Simplified computation of surge-tank action

HAROLD TULTS, Assistant Hydraulic Engineer, Pioneer Service & Engineering Co., Chicago, Ill.

The action of an important surge tank, designed according to the formulas of R. D. Johnson, D. Thoma, R. Taylor, and others, should always be checked by arithmetic integration to determine the effect of simplifying assumptions made in the development of the formulas as well as the effect of such factors as governor action and water-hammer. This procedure is cumbersome and requires a number of cut-and-try operations on 17 dependent variables, as shown by the example of arithmetic integration described in "Design of TVA Projects" (Technical Report No. 24, Vol. 1, 1952, pp. 404–406).

The writer has successfully used a simplified method without cut-and-try operations, assuming that the computed conduit velocity at the end of an interval remains constant during the next interval (that is, that the velocity varies stepwise, not continuously). Using short intervals during a rapid variation in head, the error is small and on the safe side, as the flow variation is delayed by the need for keeping the velocity constant within an interval.

Further, an important advantage in the arithmetic treatment of water-level variations in riser and tank can be obtained by computing the variation at the end of each interval. As shown in Fig. 1 (*a*) and (*b*) for load-on and load-off conditions, the variation in water level during a time interval, Δt, assuming that the variations are linear during the interval, may be expressed by the following equations:

$$H_2 = \left(Q_2 - \frac{H_2 + \Delta Z - H_1}{\frac{\Delta t}{c_o A_o \sqrt{2g}}} A_R \right)^2 \quad (1)$$

$$\Delta Z = \frac{V_s - (H_2 - H_1) A_R}{A_T + A_R} \quad (2)$$

in which

H_1 = head difference between riser and tank at the beginning of an interval
H_2 = head difference between riser and tank at the end of an interval
ΔZ = water-level variation in tank in the interval
Q_2 = rate of flow into or out of the tank at the end of the interval
V_s = total volume variation in the surge tank in the interval
A_T = area of surge chamber
A_R = area of riser pipe
A_o = area of port
c_o = port orifice coefficient
g = gravitational acceleration

For a "restricted orifice tank," where the riser area, A_R, is zero, Eqs. 1 and 2 assume simple forms:

$$H_2 = \left(\frac{Q_2}{c_o A_o \sqrt{2g}} \right)^2 \quad (3)$$

$$\Delta Z = \frac{V_s}{A_T} \quad (4)$$

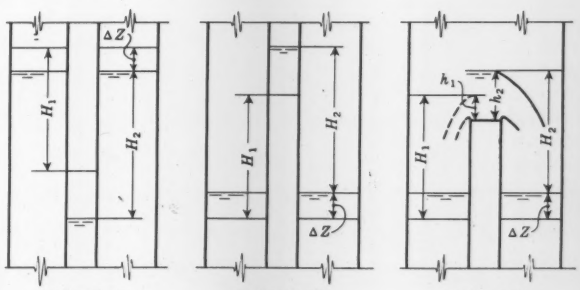


FIG. 1. Water-level variations in differential surge tank are shown for three conditions.

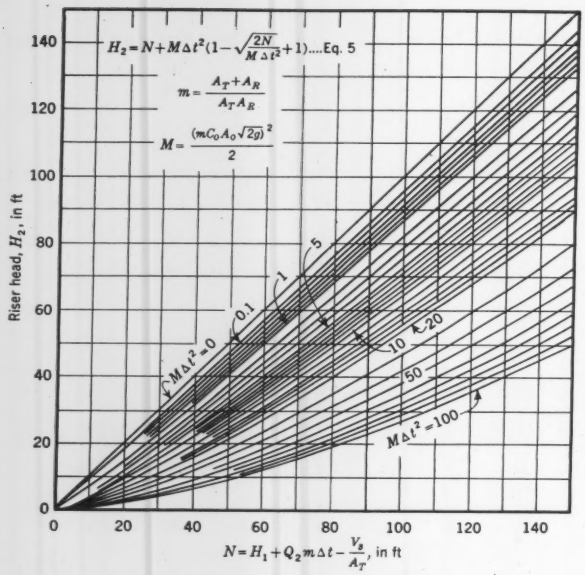


FIG. 2. Riser head, H_2, at the end of an interval, is plotted for various differential surge tanks and time intervals.

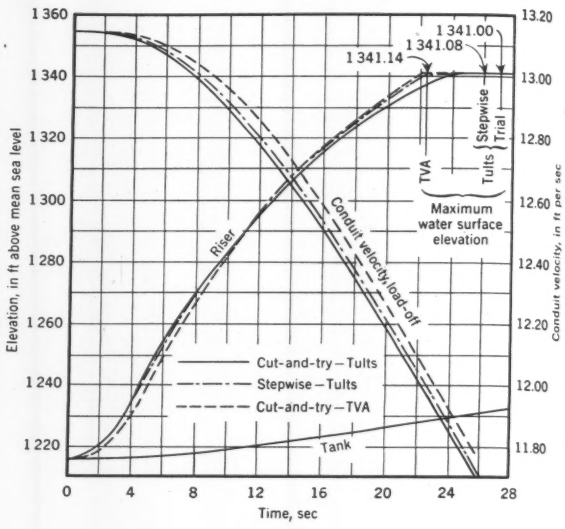


FIG. 3. Characteristic variables for tank performance are water-level elevation in riser and tank, and velocity in conduit, here plotted by three methods.

Combined and transformed for a "differential surge tank," Eqs. 1 and 2 yield the quadratic equation,

$$H_2 = N + M\Delta t^2\left(1 - \sqrt{\frac{2N}{M\Delta t^2}} + 1\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

in which N is a linear function of H_1, Q_2, and V_s.

$$N = H_1 + Q_2 m\Delta t - \frac{V_s}{A_T} \quad . \quad . \quad (6)$$

Quantities m and M are "tank constants":

$$m = \frac{A_T + A_R}{A_T A_R} \quad . \quad . \quad . \quad . \quad (7)$$

$$M = \left(\frac{A_T + A_R}{A_T A_R}\right)^2 \frac{(c_oA_o\sqrt{2g})^2}{2} = \frac{(mc_oA_o\sqrt{2g})^2}{2} \quad . \quad . \quad (8)$$

Plotted in Fig. 2 above are graphs of the function $H_2 = f(N, M, \Delta t)$, expressed by Eq. 5 covering N values from 0 to 150 for various differential surge tanks, with $M\Delta t^2$ values from 0 to 100. The use of Eq. 5, or Fig. 2 together with Eq. 2, saves much time in surge-tank computations, particularly in establishing correct assumptions in the cut-and-try method. The use of Fig. 2 also simplifies the computation for shaped surge tanks, otherwise very complicated.

When the riser is spilling, the equations for water-level variations, as shown in Fig. 1 (*c*), are:

$$H_2 = \left(\frac{Q_2 - \frac{h_2 - h_1}{\Delta t} A_R - c_w b h_2^{3/2}}{c_oA_o\sqrt{2g}}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

$$\Delta Z = \frac{V_s - (h_2 - h_1)A_R - \Sigma c_w b h^{3/2}\Delta t}{A_T} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

$$H_2 = H_1 - \Delta Z + h_2 - h_1 \quad . \quad . \quad . \quad . \quad (11)$$

in which

h_1 = head on riser crest at the beginning of an interval
h_2 = head on riser crest at the end of an interval
c_w = spillway discharge coefficient
b = length of spillway crest

The term $\Sigma c_w b h^{3/2}\Delta t$ in Eq. 10 presents the volume of falling spillway discharge between the riser and the surge tank level. The summing up of spillway discharges during the past intervals is to be carried out for a time not exceeding $\sqrt{\frac{2\left(H - \frac{h}{2}\right)}{g}}$, in which the spilled water has dropped down to the water level in the surge tank.

From Eqs. 9, 10, and 11, the cubic equation, Eq. 12, is derived:

$$c_oA_o\sqrt{2g}\sqrt{H_1 + (h_2 - h_1)mA_R - \frac{V_s}{A_T} + \frac{1}{A_T}\Sigma c_w b h^{3/2}\Delta t} + (h_2 - h_1)\frac{A_R}{\Delta t} + c_w b h_2^{3/2} = Q_2 \quad . \quad . \quad . \quad (12)$$

The simplest way to solve Eq. 12, to find the unknown head h_2, on the spillway, is by trial. Knowing the head on the riser crest, the action of a spilling differential surge tank can be exactly computed, applying Eqs. 10 and 11.

To simplify the mathematical work in computing the action of a spilling surge tank, the term $\Sigma c_w b h^{3/2}\Delta t$ may be neglected. The errors introduced by this simplification are small and on the safe side.

For purposes of comparison, the writer computed the action of the differential surge tank for the Apalachia Project of the Tennessee Valley Authority during the first 28 sec, including 5 sec of complete shutdown. For not-spilling this was computed on the basis of Eqs. 5 and 2, and for the spilling riser pipe, on the basis of the simplified Eqs. 12, 10, and 11 neglecting the term $\Sigma c_w b h^{3/2}\Delta t$.

Both were computed by the simplified stepwise integration and by the cut-and-try stepwise integration.

The variable assumed to start the computation for a step is the conduit velocity change, Δv, in a time interval,

$$\Delta v = \frac{g}{L}(Z_R - h_f)\Delta t \quad . \quad . \quad (13)$$

in which

L = length of conduit between basin and surge tank
Z_R = head difference between water levels in reservoir and riser
h_f = friction loss in conduit

The velocity change as a trial variable is converging, when the trials are made (particularly after the turbine gates have moved to the final position), because its direct effect on friction head outweighs the effect on the variation of riser head.

As characteristic variables for tank performance, the variation in the water-level elevation in riser and tank, and the variation in the velocity in the conduit, are illustrated in Fig. 3.

It is interesting to note that the water levels in the riser, as computed by the simplified stepwise method, are very close to the levels obtained by the cut-and-try method of TVA. The difference in the maximum water levels in the riser for all three methods is small. The maximum water levels by the writer's cut-and-try and stepwise methods are 0.14 and 0.06 ft respectively, lower than by TVA's cut-and-try method.

The conduit velocities, as computed by TVA and by the writer's methods, differ more. Besides differences in method, this difference may be caused by the greater accuracy of the writer's computation, in which four decimal points were used for velocities and one decimal point for flow rates and volumes.

The differences obtained when computing the action of the spilling surge tank by the writer's cut-and-try method with and without the term, $\Sigma c_w b h^{3/2} \Delta t$, in Eqs. 12 and 10, are small. The maximum water-level elevation in the riser, taking this term into account, would be 0.02 ft lower. At the same time, the water level in the surge tank would be 1.09 ft lower, but this difference would be reduced or eliminated after spilling had stopped.

It is believed that the methods shown here will simplify the stepwise integration of surge-tank action without sacrificing precision.

Deflections with varying moment of inertia

ALFRED GORDON, A. M. ASCE

Assistant Engineer (Retired), Bridge Department

Canadian Pacific Railway Company, Montreal, Quebec, Canada

Structural designers are frequently faced with the tedious task of computing deflections of members with varying cross sections. To speed these computations, the writer has calculated the accompanying Tables I-V. These tables give the ordinates, h, at the tenth points, of the influence line for the end deflection of a cantilever having a moment of inertia varying in accordance with the diagram shown with each table [as shown on the following page].

The end deflection is given by $\Delta_e = \Sigma\, Wh \times C \times l^3/EI_c$ (Fig. 1), in which W is in pounds; h is as read off the influence line; C is as given; l is in inches; E, in psi; and I_c, in (inches)^4. Table III can be adapted to simple spans symmetrical about their center line by considering the span as two cantilevers, when l will become half the span, and the deflection, as found by the above equation, must be halved.

Tables IV and V are given to cover those cases in which the curve approximating the actual I-curve of the girder is appreciably different from the second-degree parabola generally assumed. The writer has, in actual practice, computed deflections for turntables of greatly different spans and values of K, in which he would have been considerably in error by this assumption, whereas by using the proper exponent he obtained almost exact agreement with deflections obtained by the "exact" procedure, including wheel loads.

The curves can also be used to obtain reaction influence-lines for any two-span symmetrical or unsymmetrical continuous girder. For completeness, the following are the ordinates when the M/I diagram is assumed to be parabolic: 1.000, 0.840, 0.686, 0.540, 0.0406, 0.287, 0.187, 0.106, 0.048, 0.012. $C = 0.417$, $\Sigma\, h = 4.112$, $C\, \Sigma\, h = 1.715$.

The curves were calculated for the most part by numerical integration, but C, which corresponds to the coefficient 1/3 in the familiar $\Delta = 1/3 \times \frac{Pl^3}{EI}$, was determined also by strict integration. The agreement between the two methods afforded a close check on the work.

The curves for $K = 1$ in Table I, for $K = 1$ and $K = 0$ in Table II, and for $K = 1$ in Table III, were checked at all tenth points by a strict application of calculus. These checks indicate that the maximum ordinates are probably not out more than 0.005, which is more than sufficiently accurate.

The curves can also be used even if the I of the girder is uniform for some distance, as in a turntable delivering its load to loading girders, the deflection being found by the curves from the end trucks to the loading girders, and by the formula, $\Delta_2 = \frac{Wml^2}{EI_c}$ for the portion between the trucks (Fig. 1).

Apart from this, the results obtainable by the use of these curves depend only on the degree of correspondence between the actual I-curve of the girder considered and the one selected as being closest to it.

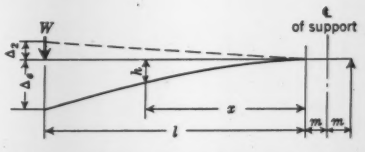
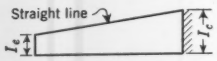


FIG. 1. Influence line for cantilever beam.

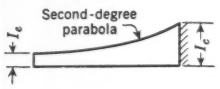
Values of h of the influence line for end deflection of a cantilever $K = \frac{I_e}{I_c - I_e}$

TABLE I



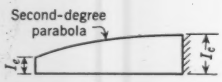
x \ K	1.0	0.4	0.3	0.2	0.1	0.05
$1.0l$	1.000	1.000	1.000	1.000	1.000	1.000
0.9	0.842	0.834	0.833	0.829	0.824	0.818
0.8	0.687	0.675	0.672	0.666	0.658	0.650
0.7	0.542	0.528	0.522	0.516	0.507	0.500
0.6	0.408	0.334	0.389	0.383	0.373	0.368
0.5	0.290	0.277	0.273	0.268	0.260	0.255
0.4	0.188	0.179	0.176	0.172	0.167	0.163
0.3	0.107	0.101	0.099	0.096	0.093	0.091
0.2	0.047	0.044	0.042	0.041	0.040	0.039
0.1	0.010	0.009	0.009	0.008	0.008	0.008
Σh	4.12	4.04	4.01	3.98	3.93	3.89
C	0.384	0.420	0.430	0.445	0.466	0.480
$C \times \Sigma h$	1.58	1.70	1.72	1.77	1.83	1.87

TABLE II



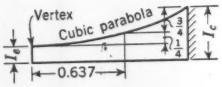
x \ K	1.0	0.4	0.2	0.1	0.05	0.0
$1.0l$	1.000	1.000	1.000	1.000	1.000	1.000
0.9	0.838	0.828	0.817	0.802	0.785	0.659
0.8	0.682	0.663	0.642	0.618	0.593	0.478
0.7	0.534	0.510	0.486	0.459	0.433	0.339
0.6	0.399	0.375	0.350	0.326	0.303	0.233
0.5	0.281	0.257	0.238	0.218	0.201	0.154
0.4	0.181	0.160	0.148	0.134	0.123	0.094
0.3	0.101	0.089	0.080	0.072	0.066	0.050
0.2	0.043	0.038	0.034	0.030	0.027	0.021
0.1	0.009	0.007	0.006	0.006	0.005	0.005
Σh	4.07	3.93	3.80	3.66	3.54	3.03
C	0.429	0.510	0.582	0.660	0.733	1.000
$C \times \Sigma h$	1.75	2.00	2.21	2.42	2.59	3.03

TABLE III



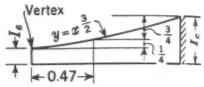
x \ K	1.0	0.5	0.3	0.2	0.1	0.0
$1.0l$	1.000	1.000	1.000	1.000	1.000	1.000
0.9	0.842	0.840	0.837	0.835	0.832	0.826
0.8	0.691	0.686	0.682	0.679	0.672	0.667
0.7	0.548	0.542	0.537	0.534	0.528	0.522
0.6	0.416	0.410	0.405	0.402	0.397	0.392
0.5	0.298	0.295	0.288	0.286	0.283	0.278
0.4	0.196	0.192	0.189	0.187	0.185	0.182
0.3	0.113	0.110	0.108	0.107	0.105	0.104
0.2	0.050	0.049	0.047	0.046	0.046	0.046
0.1	0.010	0.010	0.010	0.010	0.010	0.008
Σh	4.16	4.13	4.10	4.09	4.06	4.02
C	0.350	0.361	0.368	0.372	0.378	0.385
$C \times \Sigma h$	1.46	1.49	1.51	1.52	1.53	1.55

TABLE IV



x \ K	1.0	0.5	0.2	0.10	0.05
$1.0l$	1.000	1.000	1.000	1.000	1.000
0.9	0.840	0.832	0.814	0.798	0.772
0.8	0.682	0.666	0.637	0.607	0.562
0.7	0.534	0.513	0.476	0.440	0.384
0.6	0.397	0.376	0.335	0.302	0.257
0.5	0.278	0.257	0.223	0.195	0.162
0.4	0.177	0.160	0.135	0.116	0.094
0.3	0.097	0.087	0.071	0.060	0.049
0.2	0.041	0.036	0.029	0.024	0.020
0.1	0.008	0.007	0.005	0.004	0.004
Σh	4.054	3.934	3.725	3.546	3.304
C	0.462	0.549	0.716	0.88	1.066
$C \times \Sigma h$	1.872	2.16	2.67	3.12	3.525

TABLE V



x \ K	1.0	0.5	0.2	0.1	0.05
$1.0l$	1.000	1.000	1.000	1.000	1.000
0.9	0.840	0.833	0.820	0.810	0.799
0.8	0.684	0.672	0.650	0.632	0.617
0.7	0.538	0.522	0.498	0.479	0.464
0.6	0.404	0.387	0.364	0.346	0.333
0.5	0.286	0.271	0.250	0.237	0.226
0.4	0.185	0.173	0.158	0.149	0.141
0.3	0.105	0.097	0.087	0.082	0.077
0.2	0.046	0.041	0.037	0.034	0.032
0.1	0.011	0.008	0.007	0.007	0.006
Σh	4.100	4.000	3.870	3.776	3.695
C	0.409	0.450	0.513	0.557	0.593
$C \times \Sigma h$	1.628	1.800	1.985	2.110	2.190

THE READERS WRITE

Rapidly varied flow offers wide scope for investigation

To the Editor: In his article in the December issue on the "Hydraulic Drop as a Function of Velocity Distribution," Charles Grant Edson deals with an interesting problem of rapidly varied flow.

The problem of the free overfall has been dealt with by the following writers: Woodward (Miami Conservancy Reports, Part VII, p. 135, 1920); O'Brien (*Engineering News-Record*, Sept. 15, 1932, p. 313); Rouse (*Verteilung der Hydraulischen Energie bei einem Lotrechten Absturz*, Oldenburg, Berlin, 1933); Civil Engineering, April 1936, p. 257; Civil Engineering, July 1937, p. 518; Langbein, (Civil Engineering, May 1937, p. 349); Moore (*Transactions* of ASCE, Vol. 108, p. 1343, 1943); Southwell and Vaisey (Phil. *Transactions* of Royal Society, London, Vol. A240, p. 144, 1946); Craya (*La Houille Blanche*, 1948, Part 2, p. 185); Jaeger (*La Houille Blanche*, 1948, Part 6, p. 518); Roy (*La Houille Blanche*, 1949, Part 6, p. 832); Khafagi and Hammad (*Water and Water Engineering*, London, March 1954, p. 106 and Oct. 1954, p. 436). Some of these writers are concerned with the relation of the depth at the overfall to the depth for parallel critical flow, some with the general shape of the drop-down curve, and some with the pressure and velocity distributions involved. Not all of these discussions are of equal merit or usefulness.

The author of the article in the December issue purports to derive a general expression for the ratio of the overfall depth to the critical depth for parallel flow (D_f/D_c) and compares the values given by his analysis with values quoted by O'Brien and Rouse. It is important to point out right away that the value of $D_f/D_c = \frac{2}{3}$ given by O'Brien was based on the incorrect assumption that the pressure is zero at all depths in the overfall section. Furthermore, it is quite clear from O'Brien's article that no true confirmation of that value was obtained empirically. The value of 0.715 (given by Rouse and confirmed by Moore) has been generally ac-

cepted for the case of a horizontal channel where the Froude number of the approaching flow is less than unity. The value of 0.69 found by Southwell and Vaisey by "relaxing" the case of potential flow over the free fall is consistent with this value of 0.715 for the case of a real fluid.

The author's method of analysis raises many doubts. His Eq. 1 bears little resemblance to the equations usually derived from fundamental flow principles. It is difficult to understand how the integration leading to Eq. 2 can give the result shown without violating the author's own assumptions. The resulting Eq. 4 is only made to check Rouse's value of 0.715 by taking the flow to be a peculiar type of laminar flow, which is clearly not the case.

The field of rapidly varied flow offers wide scope for experiment and analysis. The velocity distribution in the approach flow is a factor well worth investigating, and the author is to be commended for his decision to tackle this aspect of the problem. It is unfortunate that the method of analysis used is open to such serious doubt.

JAMES C. I. DOOGE
Research Assoc. and Instructor, College of Eng., State Univ. of Iowa
Iowa City

Large savings in long-span prestressed-steel girders

TO THE EDITOR: I have read with great interest the comments by Donovan H. Lee in the January issue (p. 62) on my article, "Long Prestressed-Steel Truss Erected for Belgian Hangar," which appeared in the October issue (p. 38).

I quite agree with Mr. Lee that the economy obtained by prestressing the steel truss was moderate. This is due to the fact that the span was only 251 ft. My point has always been that this kind of construction gives big savings only when applied to spans of 330 ft and more. In such cases, the saving in weight can be as much as 25 percent and the saving in cost 18 percent, provided that the dead load of the girder is an important part of the total load to be carried.

As regards the protection of high-tensile-strength wires (of 0.276-in. diameter) against corrosion, there is no more difficulty than in protecting angles, beams, and channels, the thickness of which is seldom much more than the wire diameter.

Concerning the increase in deflection mentioned by Mr. Lee, I have drawn attention to this myself, but I do not see that it has any practical significance. It has no importance whatever in the construction of roofs for aeroplane hangars. In the case of bridges I believe that the classical specifications for maximum acceptable deflection are far too conservative and that they are not based on scientific considerations.

G. MAGNEL, M. ASCE
Professor, Univ. of Ghent
Ghent, Belgium

On use of hand level in bright sun

TO THE EDITOR: An experience of mine may be of some interest. Two summers ago, while working for the Oregon State Highway Department, I was running cross sections with a hand level on a location job. The bright sun was making the bubble almost unbearable to look at. I took a piece of green scratch paper and wrapped it around the bubble and used rubber bands to hold it on. I could then see the sharp outline of the bubble and didn't have to shade the level with my hand. The idea has been used by other transitmen since I first stumbled on it.

SPENCER E. GRAY, *Member, Oregon State Col. Student Chap. of ASCE, Class of '55*
Corvallis, Ore.

Early history of slope deflection method traced

TO THE EDITOR: Having had, for two and one-half decades, a close personal contact with slope deflection theory and modern theory and modern methods of solution of the slope deflection equations, the writer was interested in the article, "Continuous Beams Analyzed by Slope Increments," by F. A. Wallace, in the December issue. The method Mr. Wallace presents is not essentially different from the general methods presented by the writer independetly and in collaboration with the late George A. Maney, M. ASCE, some years ago. Among the papers which contain these methods are the following: "Vertical Load Analysis of Rigid Building Frames Made Practicable," *Engineering News-Record*, Nov. 12, 1931; "Wind Stresses by Slope Deflection and Converging Approximations," *Proceedings*, May, 1933, and *Transactions*, 1934; "Analysis of Two-Column Symmetrical Bents and Vierendeel Trusses Having Parallel and Equal Chords," *Journal of the American Concrete Institute*, November 1947; and "Simplified Methods for the Analysis of Multiple Joint Rigid Frames," *Northwestern University Bulletin*, 1932. The first of these papers outlined and illustrated the successive approximation procedure for building frames without side sway. Mr. Wallace's problem of the continuous beam is, of course, simply a special case of the more general problem of the frame without side sway.

The use of the fixed-end moment as the starting point of the analysis of frames and continuous beams goes back to Professor Maney's paper, "Engineering Studies No. 1," University of Minnesota, 1915. It is likely that in a great measure this paper also deserves some credit for indicating implicitly that the flexural stiffness of a prismatic member is the now well-known $4EI/L$. Following Manderla in the 1880's, Otto Mohr discussed and simplified the solution of a certain slope deflection problem, specifically that of secondary stresses in trusses. Mohr observed that the matrix of the slope deflection equations for the secondary stress problem possessed the property of having relatively large coefficients for the terms on the diagonal and could therefore be solved by Gauss's iterative procedure. This method appears to have been used in this country first by Allston Dana, M. ASCE, in 1915 in an analysis of secondary stresses.

In the writer's paper of 1931, covering the iterative method for loaded frames, a more selective order of progression through the equations was suggested, which appears to lead to the most rapid convergence. The procedure differs slightly from the usual form of the Gauss-Seydel technique. It may be pointed out that the method presented in the 1931 paper does not require the equations to be written explicitly.

These methods have found their way into some of the available textbooks, for example, Parcel and Maney's *Statically Indeterminate Stresses*, 2nd Edition, 1936. They have been taught to undergraduates at Purdue, and perhaps at other schools, for a number of years.

JOHN E. GOLDBERG, M. ASCE
Assoc. Prof. of Structural Eng., Purdue University
Lafayette, Ind.

Alternate-joint procedure recommended

TO THE EDITOR: In reference to the article by F.A. Wallace, "Continuous Beams Analyzed by Slope Increments," in the December 1954 issue (p. 66), this slope increment solution can be applied to rigid-frame problems or to any continuous structure equally well. More rapid convergence of the incremental changes can be realized, while keeping the rotation of the joints and configuration of the structure clearly in mind, if an alternate-joint procedure is used in the solution of the slope deflection equations, rather than the consecutive joint procedure outlined in the article. This method of solving the slope deflection equations and the alternate-joint procedure, were introduced in a paper by J.E. Goldberg, "Vertical Load Anaylsis of Rigid Building Frames" (*Engineering News-Record*, Nov. 12, 1931). The solution of the slope-deflection equations realized in continuous beams and frames by these successive approximation methods have been taught to undergraduate students at Purdue University and other schools for some time.

K. H. LENZEN, A.M. ASCE
Instructor, School of Civil Eng., Purdue Univ.
Lafayette, Ind.

SOCIETY NEWS

EJC Explores Its Public Service Opportunities

Hope for a unification of the profession based solely on serving the public welfare was expressed in the opening address at the first General Assembly of Engineers Joint Council, by Thorndike Saville, M. ASCE, president of EJC and dean of engineering at New York University. The all-day program, which was held in New York on January 21, brought together some 400 engineers representing the eight constituent EJC societies and other organizations.

With emphasis on EJC's opportunities for public service, the program included open-forum discussions of such topics as nuclear engineering developments, the effect of unionization on the engineer, engineers and the national well being. Many of the nation's leaders in engineering, industry, science, and government headed the discussion panels.

Nuclear Engineering Developments

Further details of the Nuclear Engineering and Science Congress, which EJC is sponsoring in Cleveland, December 12–16, 1955, were announced by John R. Dunning, dean of the Columbia University School of Engineering and general chairman of the EJC committee for the congress. The program is being arranged by Prof. Donald L. Katz, chairman of the Chemical and Metallurgical Engineering Department at the University of Michigan. It is expected that some of the important papers given at the United Nations Nuclear Energy Congress, scheduled for Geneva in August of this year, will be available for presentation at the Cleveland congress. Papers contributed by ASCE will generally relate to atomic plant site selection, pressure housing for plants and reactors, shielding of personnel against atomic radiation, and disposal of atomic waste. Each EJC society and six other interested engineering and scientific groups are expected to participate.

In a discussion of the engineering changes introduced by atomic energy, Miles C. Leverett, engineering manager of aircraft nuclear propulsion for the General Electric Company, pointed out "the value of good fundamental training" to engineers engaged in the field. They must have a broad outlook and be "sufficiently flexible so that they can think and operate effectively in a number of technical fields." Because the industry at present is dominated by considerations of technical feasibility, the engineers and scientists in it have not yet acquired a dollar-sense. They "are only beginning," Mr. Leverett said, "to realize the meaning of economic competition and to acquire the techniques of controlling and making choices on economic grounds . . . If the nuclear engineer can expect his professional experience to parallel that of the aeronautic engineer he has, indeed, a most exciting and productive future to look forward to. The field is broad and satisfyingly full of opportunity."

Manpower Shortage

Engineering manpower and the activities of the Engineering Manpower Commission of EJC were major subjects of the Assembly. Speaking frankly, Donald R.

Thorndike Saville, M. ASCE (left in top photo), who will serve as president of EJC for another year, chats with ASCE Past-President Carlton S. Proctor, reelected vice-president of EJC. In lower view S. C. Hollister, M. ASCE, dean of the Cornell College of Engineering, reports the findings of EJC's Engineering Manpower Commission.

Prominent on the program for EJC's first General Assembly, held in New York on January 21, are (left to right) Stewart E. Reimel, M. ASCE, secretary of EJC; Dr. H. S. Osborn; E. Lawrence Chandler, Assistant Secretary of ASCE and treasurer of EJC; C. E. Davies, secretary of ASME; and G. Brooks Earnest, M. ASCE, who headed a panel discussion on engineers and unionization.

Quarles, Assistant Secretary of Defense, Research and Development and the banquet speaker, said that ". . . the Communists have modernized their educational system to orient it strongly toward the physical sciences and industrial technology. They are turning out engineers and scientists at more than twice the rate in this country.

"We still have a stronger and more virile industrial system. We can stay ahead in this technological race," he declared, "but in the military field we are competing with a ruthless concentration of aims of a militant communism." It is important for us, he pointed out, to work toward national policies that enhance and conserve our engineering manpower. There are good policy reasons for insisting that no young man escape the sacrifices that other young men must make in military service. However, engineers are scarce. The military services require some specialists to perform their missions. "Beyond this we cannot afford to put engineers and scientists in uniforms." Nevertheless, industry is obligated to develop the full potential of each engineer in his employ and to "avoid waste of his talents on nontechnical duties."

In summarizing the work of EJC's Engineering Manpower Commission, S. C. Hollister, M. ASCE, dean of the Cornell University College of Engineering, pointed out that engineering schools got out of the "G.I. bulge" in 1949, but that in 1950 the shortage of engineers began to show up. When the Federal Government asked EJC for help in tackling the problem and applying corrective measures the Engineering Manpower Commission was formed. Its threefold program includes (1) aid in maintaining a supply of trained engineers; (2) promotion of the most effective utilization of engineers in the maintenance of the national health and safety; and (3) aid in establishing the importance of the engineering profession to the national economy.

During the past year, the EMC has coordinated its efforts with those of the Scientific Manpower Commission (SMC). This cooperation between EMC and SMC has saved time, energy, and expense in carrying out their joint objectives. One noticeable result is that freshman engineering enrollment in the Fall of 1954 is slightly higher percentagewise than in 1953. The shortage of mathematics and science teachers in high schools continues serious.

Unionization Held Not Professional

In opening the panel on "Employment Conditions and Unionization—Their Effect on the Engineer," G. Brooks Earnest, former Vice-President of ASCE and chairman of the panel, reported for the first time on results of a questionnaire submitted by ASCE, ASME, and AIEE to their 127,000 members. Of the 112,225 questionnaires sent out, 57 percent responded, a high percentage.

He said that "Only 2,348, or 3.7 percent, were actually members of an established collective bargaining group. However, 17,318, or 27 percent, reported themselves as not opposed to collective bargaining. Furthermore, 12,833, or 20 percent, reported they believed collective bargaining would be advantageous to them. Of 8,199 reporting from two member societies in this category (the third did not ask the question), 347, or less than 1 percent, would prefer to be represented by a craft or labor union.

"It is important to note that 45,992, or 72 percent, of the 64,026 returns opposed collective bargaining for professional engineers and that 42,314, or 66 percent, felt collective bargaining is incompatible with professional status."

Assuming that those who did not respond to the questionnaire might approximate the thinking of those who did respond, "there then would be 30,400 members who are not opposed to collective bargaining for professional engineers."

These results present a challenge to the engineering profession Dr. Earnest said. "We are charged with the responsibility of first converting 30,400 of our members to true professional status."

To the question, "Is Collective Bargaining Compatible with Professional Status," Prof. Nathan W. Dougherty, M. ASCE, dean of engineering at the University of Tennessee, voiced an emphatic negative. He reminded, "Bargaining groups cannot grow into unity or professional associations. They are committed to the concept of jurisdictions rather than performance with requisite knowledge and skill. They must emphasize seniority to hold membership and strength. Jurisdiction and seniority are in direct conflict with the concept that ability must be recognized and given first place.

"Why should a professional have to turn to collective bargaining to get a salary raise? If such conditions exist it is because professionals in management are not assuming their responsibility. Any connection or pressure from management or fellow workers which tends to reduce the engineers' freedom to make judgments is a menace to his status and harmful to his position."

The figures reported by Chairman Earnest moved E. Lawrence Chandler, Assistant Secretary of ASCE and treasurer of EJC, to comment: "Even though only a little more than 3 percent of the membership of three societies are members of unions, we are challenged by the circumstances that so many express a favorable reaction in spite of the fact that the essence of collective bargaining is so foreign to the basic concept of professionalism and to the fundamental thinking inherent in creative engineering.

"Why is this so? Management and employees have responsibilities to each other. If each will realize and meet proper obligations, employment conditions surely will become more favorable for all concerned."

Mr. Chandler continued, "If a professional engineer wants to be considered a part of management, he must be willing to accept the responsibilities that go with that consideration. If he feels that he is not getting proper recognition, it well may be that a critical self examination is in order. One cannot wish himself up the ladder. It remains for each individual to prove by his own ability, integrity and conscientious application to duty that he deserves recognition."

Service Opportunities for EJC

Speaking as vice-president of EJC, Carlton S. Proctor, Past-President of ASCE, stated bluntly that "the question of EJC's responsibilities and obligations are far more important than the details of its organizational structure.

"If EJC will steadfastly adhere to the elemental principles, inherent in its organization, that it shall emphasize the public service attributes of the engineer, and that through its efforts educational and ethical standards shall be advanced, then will our profession attain that public status so long sought but not attained. Status must be earned and conferred; it cannot be bought or coerced.

"Let's insist that EJC represent the entire profession in its highest aspirations; let's maintain such close liaison with constituent societies through their governing bodies that a harmony of interest and effort will result.

"Let's learn to walk together. Let's forget the organizational detail of individual membership, at least until we have demonstrated our capacity to integrate the professional activities of the several branches of our profession. Let's concentrate on the many subjects on which we are on common ground and forget matters of conflicting interest."

Earnestness of expression marked the forum presentation, and questions freely propounded from the floor were answered with equal earnestness.

The constituent societies of EJC are ASCE, AIME, ASME, AWWA, SNAME, ASEE, and AIChE, which together have a membership of 170,000 engineers. Dean Saville was named president for a second term, Edgar J. Kates, of New York, becoming vice-president. E. Lawrence Chandler, of New York, was reelected as treasurer, and Brig. Gen. Stewart E. Reimel (retired) of Washington, D.C., secretary. E. P. Lange is assistant secretary.

W. H. Wisely Takes Up Duties at Society Headquarters

W. H. Wisely, M. ASCE, who has been appointed to succeed William N. Carey as Executive Secretary of ASCE, is already at work at Society Headquarters where he will serve as Associate Secretary pending Secretary Carey's retirement on May 1. Until recently Mr. Wisely was executive secretary of the Federation of Sewage and Industrial Wastes Associations and editor of its journal, "Sewage and Industrial Wastes."

ASCE Members Aid in Readership Survey

What is your favorite CIVIL ENGINEERING feature? Which article do you like best? In what order do subject, author's reputation, and visual appearance influence your choice of "best" article? How can advertising be made more helpful to you? How can CIVIL ENGINEERING be made more useful to you?

These are some of the questions to which the editors of CIVIL ENGINEERING have been seeking answers in the past few years through a readership survey. In this quest for straws in the wind, questionnaires have been mailed each month since 1949 to some 200 members of the Society selected at random. In response to the questionnaires, almost 5,000 engineers have taken time and pains to tell us what they think is wrong and to make suggestions for improvement. They have also given us hundreds of ideas for articles. The help of these members is gratefully acknowledged.

The average member of the Society devotes 3 hours and 11 minutes reading time to CIVIL ENGINEERING each month, the survey indicates. As might be expected, the feature articles are overwhelmingly the first choice of the respondents, and News Briefs are a clear-cut second choice. In registering his preference for a particular article, the average reader says that he is influenced first by subject matter, next by the visual appearance of the article, and finally by the author's reputation. It is of interest to discover that the most impressive efforts are not necessarily the most popular. More than once a brief study of some phase of professional practice—salaries, trade unions for professionals, the problems of young engineers, bidding practice—has made first place.

A month-to-month tabulation of the most professionally useful articles published in 1954, as indicated in the 792 questionnaires returned, is given in Table I. It will be noted that three articles and four authors shared honors for first place in the June issue, the voting being so close it was impossible to single out one article.

Preferred departments for the year, according to the 792 recorded replies, are:

1. Feature Articles
2. News Briefs
3. Equipment, Materials, and Methods
4. Do You Know That
5. Advertising
6. News of Engineers
7. Engineers' Notebook
8. Society News
9. Catalog Digest
10. Notes from the Local Sections

In answer to the question, "Do the advertisers in CIVIL ENGINEERING help keep you up to date on equipment and materials used in your work?" 569 respondents said that they do, and 132 said that they do not. Advertisers should be interested in answers to the query, "In your work, do you direct the procurement of equipment and material." To this one, 98 readers said that they buy equipment and materials; 326 that they are consulted in its purchase; 305 that they specify it; and 218 that they are in no way concerned with procuring equipment and materials.

Incidentally, the Catalog Digest, which is published only twice a year, appears to be much more popular than its position ninth on the list of preferred departments would seem to indicate. The most recent Digest (October issue) elicited 30,000 inquiries about the 159 pieces of manufacturers' equipment listed.

Table I. 1954 Articles Selected as Best in Readership Survey

MONTH	TITLE	AUTHOR
Jan.	Buildings no barrier to Chicago's Congress Street Superhighway	V. E. Gunlock
Feb.	Tough terrain conquered by builders of West Virginia Turnpike	C. H. Peterson
Mar.	Materials combined to advantage in Livestock Pavilion	Fred N. Severud
April	Development of nuclear power for peaceful purposes	Henry D. Smyth
May	Competitive bidding for professional services not in the public interest	William N. Carey
June	World's third tallest structure erected in Greenland	S. D. Sturgis, Jr.
	High-level cantilever bridge spans Savannah River	Alfred Hedefine, Thomas R. Kuesel
	Ground Subsides in Houston area	Mason G. Lockwood
July	Forced to join a union? It can happen to you	L. Stewart McCoy
Aug.	Water—a critical material	Gail A. Hathaway
Sept.	Maintenance of high-speed, high-traffic highways a difficult problem	S. E. Ridge
Oct.	Good concrete with coral and sea water—1. Coral aggregate	D. Lee Narver
Nov.	St. Lawrence Seaway and Power Projects started	Emerson C. Itschner
Dec.	Compressed concrete pedestal piles form foundation for Corlears Hook Apartment Project	J. H. Thornely

Student Chapter Banner Approved by Board

A distinctive Student Chapter banner, recommended by the ASCE Committee on Student Chapters, has been approved by the Board of Direction, and the first twenty-five are now in stock at Society headquarters in New York. The 5 by 7-ft banner is exactly like the blue and gold banner used by Local Sections and at Society conventions except that the bunting is maroon, the same color as student badges.

Possible uses for the banner include the decoration of rooms for Chapter meetings and gatherings including social affairs; a rallying marker for Chapter membership campaigns; a marker in the corridor on the day of Chapter meetings; the place of honor in Chapter or departmental office or library; for identification of Chapter exhibits on career day, homecoming, open house, etc.; and for many other occasions when it is desired to express pride in the Chapter, the Society, and the profession.

The price of the Student Chapter banner is $25 postpaid, from the Executive Secretary of the Society, 33 West 39th Street, New York 18, N.Y.

New York Urged as Site for Engineering Center

The case for New York as the site of the proposed Engineering Societies Center Building is presented by the Committee for the New Engineering Societies Building in New York in a well-documented report that has been forwarded to the Board of Trustees of United Engineering Trustees, the Committee of the Five Presidents, and the Boards of Directors of the five societies principally concerned. The Committee of Five Presidents is expected to meet early in February for the purpose of recommending a site to the boards of the five societies.

In a letter transmitting its report, the New York Committee declares that "A considerable responsibility rests upon those who must decide upon the location of the future home of the engineering societies." Noting that the "New York area is still unsurpassed for the most effective carrying out of headquarters functions," it states that the Metropolitan Sections of the societies and "civic and industrial leaders as well have declared their interest and support." More specifically, it reveals that "at a meeting in December a group of industrialists pledged themselves that over and above funds already available if headquarters is kept in New York, they would stand good for the purchase price of the Columbus Circle property [January issue, page 65] if such a location were acceptable to the five societies. While this should not be a controlling factor," the New York Committee concludes, "it is tangible evidence that financial support will not be lacking in New York."

A recent editorial in the *New York Times*, entitled "No Headquarters Like New York," supports the contention of the New York Committee that "New York is not apathetic in the matter." It says, "To the five engineering societies, civil, mechanical, electrical, mining, and chemical, that are being tempted to move their headquarters elsewhere, we want to say that New York City would hate to see you go.

"After all," the editorial continues, "there is no headquarters city like New York, as many have discovered. The extraordinary concentration in this metropolitan area of engineers, of related professional men, of corporate management dependent on engineering and technical services . . . cannot be duplicated anywhere. No temporary initial advantage offered elsewhere can outweigh New York's long-term advantage as a site for a new headquarters. . ."

The New York Committee is headed by William H. Byrne, ASME. ASCE members represented are Past-President, Richard E. Dougherty, Wallace K. Harrison, Malcolm Pirnie, Jr., and Kirby Smith.

Mining Engineer Wins Alfred Noble Prize

This year the Alfred Nobel Prize goes to C. Sheldon Roberts, a young mining engineer and member of the American Institute of Mining and Metallurgical Engineers. A joint award of the Four Founder Societies and the Western Society of Engineers, the Alfred Noble Prize is presented annually to a young member of one of the sponsoring societies for a technical paper published in one of their journals. Mr. Roberts, who is research metallurgist for the Dow Chemical Co., Midland, Mich., is honored for his paper on "Creep Behavior of Magnesium-Cerium Alloys," which was published in the May 1954 issue of the AIME's *Journal of Metals*, Transactions Supplement.

Mr. Roberts entered Rensselaer Polytechnic Institute in 1943 and completed his sophomore year before entering the Navy in 1944. He underwent training as an electronics technician, serving in that capacity until his discharge in 1946. Returning to Rensselaer, Mr. Roberts graduated as a bachelor in metallurgical engineering in 1948. That fall he entered the graduate school of metallurgy at Massachusetts Institute of Technology, completing the work for the M.S. degree in 1949 and Sc.D. degree in 1951. Since then he has been in the Metallurgical Laboratories of the Dow Chemical Co.

The prize, consisting of a cash award of $400 and a certificate, will be presented to Mr. Roberts at the annual meeting of the AIME in Chicago in February.

C. Sheldon Roberts

ESL Issues Bibliography on Professional Unionization

In response to many requests, the Engineering Societies Library has prepared a *Bibliography on Unionization of Professional Engineers*, an eight-page mimeographed compilation, which may be purchased for $2. The 100 references in the Bibliography are to pamphlets and magazine articles, covering the period from 1937 to 1954. Identified as ESL Bibliography No. 10, the publication is available from the Library, 29 West 39th Street, New York 18, N.Y.

Educational Opportunities Open to Members of ESNE

The Engineering Societies of New England is sponsoring a group of educational lectures for its members. Six lectures on elementary structures are being given by educators from three different colleges. These will be followed next winter by twelve additional talks constituting an advanced course. The first of the series, a lecture on Statics, was presented by Professor P. S. Rice, of Tufts College, on January 18. The other lectures and the dates of delivery are; Beam Theory, February 1; Properties of Cross Sections, March 1; Structural Analysis, March 15; Elementary Concrete Design, March 29; and Elementary Steel Design, April 12.

Sponsoring groups, in addition to the ESNE, are the Associated General Contractors of Massachusetts, Inc., the Eastern Massachusetts Association of Professional Engineers and Land Surveyors, and the Massachusetts State Engineers. The series is free to members of ESNE and $5.00 to non-members. The lectures are being given at the American Academy of Arts and Sciences in Boston.

ASCE Membership as of January 10, 1955

Members	8,777
Associate Members	11,251
Junior Members	17,745
Affiliates	70
Honorary Members	44
Total	37,887
January 10, 1954	36,955

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

A battery of speakers from the Illinois Division of Highways covered the proposed Illinois River bridge at Peoria at a recent dinner meeting of the **Central Illinois Section.** Taking part were D. M. Costello, assistant district engineer; Robert Duncanson, district soils engineer; Harold Owen, of the Bureau of Bridge and Traffic Structures; and S. E. Wiley, field engineer. The proposed Illinois Road Test, which would provide for more equitable distribution of highway costs, was explained at the annual meeting by W. E. Chastain, Jr. New Section officers, installed during the program, are W. E. Hanson, president; R. B. Peck and J. R. Gardner, vice-presidents; and W. H. Munse, secretary-treasurer.

New ASCE Director Don M. Corbett, of Indianapolis, spoke briefly on the Society at a recent joint meeting of the **Central Ohio Section** and the Student Chapters at Ohio University and Ohio State University. In the featured talk Alden E. Stilson, Columbus consultant, gave an idea of the problems engineers must solve in locating proposed expressways through Columbus.

How reinforced concrete lift slabs are constructed and raised into position was brought out in the featured talk at the **Cleveland Section's** dinner meeting on December 17 by Frank P. Andrews, general manager of the Ohio Lift Slab Company. Slides of various projects, on which the method was employed, added much to his talk.

Herbert E. Prater, regional engineer for the Bureau of Reclamation at Denver and a colonel in the 408th Reserve Engineer Brigade, was elected president of the **Colorado Section** at its annual dinner meeting and dance. In the same election Francis M. Bell, district engineer of the Surface Water Branch of the Geological Survey in Denver, was chosen vice-president, and Dewey S. Wright, city engineer of Denver, secretary-treasurer. There was an attendance of 175.

Herbert Prater

Revision of Connecticut's Registration Act to permit the practice of engineering in the state by corporations, with adequate safe guards, was discussed at a recent highly successful joint meeting of the **Connecticut Section** and the Connecticut Society of Civil Engineers. The featured speakers were James C. Beach, chairman of the Connecticut Technical Council's Committee on Registration, and Newman E. Argraves, chairman of the State Board of Registration for Professional Engineers and Land Surveyors. Both the Section and the Connecticut Society passed motions approving the proposed changes, and the matter will be brought up in the next session of the State Legislature by the Connecticut Council and the State Board.

New officers of the Little Rock Branch of the Mid-South Section are (in usual order) William C. Marak, secretary-treasurer; Robert F. Oates, president; and John T. Pendergrass, vice-president. Messrs. Marak and Oates are Junior Members.

Emphasis has been on professional subjects at recent monthly meetings of the **Duluth Section.** At the November meeting C. A. C. Papenfuss, supervisor of the Development Engineering Department of the Minneapolis Honeywell Co., described his experiences with collective bargaining and outlined the history of its development in relation to engineering. In a talk on professional unity, given at the December meeting, Nordahl Rykken, assistant manager of Whitney Aircraft, compared developments in the engineering field with the situation in such other professions as medicine and law.

The Indiana Section made 1954 a bumper year by securing 400 dues-paying members out of a possible 500 assigned to the area. For the ninth consecutive year the Section published an eight-page newsletter, which went out about every

New Georgia Section officers, installed at the Section's recent annual meeting in Atlanta, pose with a group of ASCE officers headed by President William R. Glidden, who addressed the principal luncheon meeting on "Private Engineering Practice and Public Works." Seated in the usual order are C. E. Drummond, Jr., retiring Section president; Mr. Glidden; and incoming Section president, James B. Wilson. Standing are Byron Bledsoe, vice-president of the Section; ASCE Vice-President Frank Weaver; Dan E. Sewell, vice-president at large; ASCE Director G. P. Willoughby; and Burton J. Bell, secretary-treasurer of the Section. There was an attendance of 150 for the day-long technical program which featured a panel discussion on development of local water resources. During the evening dinner meeting certificates of life membership were presented to B. M. Hall, Jr., of Atlanta; Clarence M. Weston, of Savannah; and William A. Young, of Macon.

two months to keep members abreast of Section and Society doings. New officers, elected at the annual meeting on December 16, are W. E. Harrison, president; J. H. Byrd, vice-president; R. M. Brown, secretary-treasurer; and R. J. Cooney, assistant secretary. Prof. E. A. MacLean and C. H. Bechert will be directors of the District 9 Council.

The part played by the Atomic Energy Commission in promoting exploration for uranium ore and in financing the mining and milling of the ore was explained by Ernest E. Thurlow, of the AEC, at the **Intermountain Section's** annual meeting, held in Salt Lake City on December 16. New officers, installed during the meeting, are J. W. Odell, president; Dean K. Fuhriman, vice-president; and Ralph E. Spears, secretary-treasurer (for a two-year term).

Robert K. Morris (third from left) is installed as president of the Central Ohio Section at the group's annual meeting in December. Other officers (past and present) are shown with him in usual order. They are Roy T. Underwood, secretary-treasurer; Leslie D. Harrison, retiring president; Alvan Tallmadge, past-president and installation officer; Thomas W. Singell, first vice-president; and Charles B. Smith, second vice-president.

In keeping with the growing importance of highways in the national picture, both the **Maine Section** and its **New Hampshire Branch** sponsored conferences in the field in December. All phases of the urban highway problem were reviewed at the Section's two-day conference, its fifth, which was held at the University of Maine. It was a first conference for the Branch, which cooperated with the civil engineering department of the University of New Hampshire and featured a student paper competition. Attendance at each conference was well over a hundred, and enthusiasm ran high.

Presentation of life membership certificates was an important feature of the **Maryland Section's** annual meeting, held in Baltimore on December 8. Honored were Herschel H. Allen, George E. Finck, David W. Fry, and O. H. Schroedl. In the featured talk, entitled "Some Aspects of Modern Physics," Theodore H. Berlin, associate professor of physics at Johns Hopkins University, covered phenomena of super-fluidity and super-conductivity and high-energy physics. The annual election of officers resulted as follows: W. L. Chilcote, president; W. Watters Pagon, vice-president; and W. Worthington Ewell, secretary-treasurer.

Present methods of determining the pollution of bathing beach areas were challenged at a recent meeting of the **Metropolitan Section's** Sanitary Engineering Group, held at Columbia University. Harold Romer, chief of the Division of Waste Disposal and Pollution Control for the New York City Department of Health, listed six significant weaknesses of sampling and testing, which may occur. He also urged establishment of a committee to develop uniform guides to pollution evaluation. An improper evaluation of the polluting effect of the tides is another weakness in present practice, according to Mr. Romer. In New York's Coney Island area, he said, the incoming tide has yielded more than eight times as many coliform organisms as the outgoing tide. Therefore, an average of incoming and outgoing coliform densities cannot reflect a valid public health picture and is a misleading measure of pollution conditions. Neither have the effects of tidal range been properly evaluated, since tidal ranges of 6 ft may carry almost four times as much pollution as 3-ft tides. In addition, Mr. Romer took issue with the use of logarithmic averages, which minimize the effect of high coliform densities, and recommended the use of arithmetical averages," which have greater public health meaning." Log averages may not be used without sound mathematical reasons. Other members of the panel were Richard McLaughlin, director of sanitation for Westchester County; T. K. McCormick, director of sanitation for Nassau County; and Alfred Fletcher, of the New Jersey Department of Health.

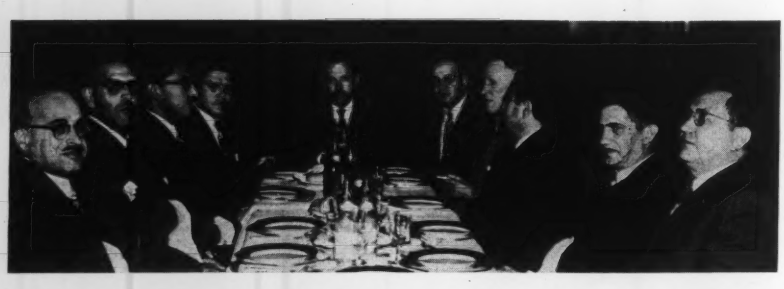
New **Michigan Section** officers are John C. Kohl, president; Fred H. Burley, first vice-president; and Louis D. Kirshner, second vice-president. Lloyd T. Cheney was unanimously reelected secretary-treasurer.

Plans of the Montana Highway Commission for roads in the Billings area were discussed at a recent meeting of the **Billings Branch** of the **Montana Section** by Paul Johnson, division engineer for the Commission. During the meeting Mr. Johnson took office as Branch president for 1955. The other new officers are Wendell Allison, vice-president, and Arthur L. Schwenneker, secretary-treasurer.

Kenath A. Kettle (left), past-president of the West Virginia Section, presents a life membership certificate to Howard A. Levering at a meeting in Huntington. Col. George T. Derby, district engineer for the Huntington District of the Corps of Engineers, gave an illustrated talk entitled, "Ohio River Navigation Structures Take on a New Look."

The economic outlook for the Republic of Panama was discussed at the **Panama Section's** annual meeting—held at Balboa Heights on December 6—by Mario de Diego, general manager of the Institute of Economic Development for the Republic. During the program the incoming slate of officers was introduced to the Section. They are Guillermo Rodriguez, president; Leo W. Cagley, first vice-president; Frank R. Molther, second vice-president; and Robert J. Risberg, secretary-treasurer.

The future through the eyes of the power engineer was the challenging theme of the **Philadelphia Section's** December meeting—a joint session with the local group



Viewed at a recent dinner meeting of the Mexico Section in Mexico City are (proceeding clockwise around the table) Francisco Gómez-Pérez, José V. Orozco, Neftalí Rodriguez, Miguel Montes de Oca Alcaraz (treasurer), Guillermo Salazar Polanco (secretary), Armando Santacruz, Jr. (president), George D. Camp, José Vázquez del Mercado, Francisco Rodríguez-Cabo and Leopoldo Farías. In an interesting talk on "The Use of Radioactive Isotopes and X-Rays in Some Control Problems," Mr. Polanco described methods and apparatus in general use today for the investigation of metallic structures.

Executive Secretary William N. Carey was principal speaker at the Puerto Section's annual dinner-dance, held at San Juan in December. Shown with him here are the newly elected officers: Stanley Kadala, secretary-treasurer; Kenneth W. Ahbol, vice-president; Jose M. Canals, president; Secretary Carey; Franklin O. Rose, retiring president; and Jorge J. Jimenez, vice-president. In the enthusiastic discussion that followed Mr. Carey's talk it was decided that there is need for the "technician" in the engineering field, and that professional engineers should receive a broader education.

of the ASCE and the Mechanicals acting as hosts. Theodore Baumeister, Stevens Professor of Mechanical Engineering at Columbia University and consultant to public utilities and industries in the power field, was featured speaker.

The program for the **Providence Section's** December dinner meeting dealt with the construction of two $5^1/_2$-mile-long, 55-ft-dia tunnels, which supply water to Sir Adam Beck-Niagara Generating Station No. 2 at Niagara Falls. The mammoth project was described by H. A. Letoile, assistant to the president of B. Perini & Sons, the general contractors.

The civil engineer's vital role in the community is being played up by the **Seattle Section's** Community Projects Committee, which is headed by Section Past-President Harlan H. Edwards. Established with the idea of keeping Section members informed about proposed public works, this committee in a brief year has become one of the Section's most popular activities. In addition to supplying impartial information to both the membership and the public, the committee fills a special community need in helping to settle controversial issues that come up within or between public bodies. "The reconciling of apparently different points of view to arrive at a satisfactory final understanding is one of the most valuable services such a committee can render its community," says Mr. Edwards. The committee consists of from ten to fifteen engineers—persons of broad responsibility who are recognized by the committee as having sound judgment. Working with the group are study committees of the same size, one for each project or subject being studied. Currently there are six such committees at work on the following projects (each with its obvious controversial aspects): (1) Flood control, drainage, and industrial planning of the Duwamish River Valley; (2) proposed bridges across Lake Washington and Puget Sound; (3) the Tacoma-Seattle-Everett Freeway; (4) Seattle's needs in sewage and garbage disposal and elimination of air pollution; (5) parking and traffic problems; and (6) the new Seattle Zoning Code and Comprehensive Plan.

Several new policies of the **Spokane Section** made 1954 an especially successful year, the Section reports. These include establishment of a two-page monthly newsletter and supplementing the regular schedule of monthly meetings with four major meetings. New Section officers are: J. Byron Barber, president; C. A. Moore, first vice-president; W. W. Wilson, second vice-president; and John F. Mangan, secretary-treasurer. The Section is in its forty-second year.

At its annual meeting, held in Milwaukee on December 16, the **Wisconsin Section** presented a certificate of life membership to Charles Whitney and elected new officers—Ralph P. Larsen, president; Arno Lenz, first vice-president; Richard C. Dess, second vice-president; and Herbert Goetsch, secretary-treasurer. The technical program consisted of a talk on the development of aluminum structures in the British Isles.

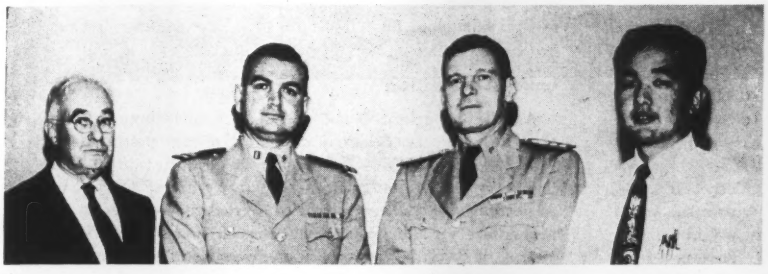
Scheduled ASCE Conventions

SAN DIEGO CONVENTION
San Diego, Calif.
Hotel U. S. Grant
February 7–12, 1955

ST. LOUIS CONVENTION
St. Louis, Mo.
Jefferson Hotel
June 13–17, 1955

NEW YORK CONVENTION
New York, N.Y.
Hotel Statler
October 24–28, 1955

Nevada and Central Valley Subsections of the Sacramento Section combine for a two-day field trip that took in Weed Heights Mine and Mill at Yerington, Nev., the Leviathan Sulphur Mine northeast of Markleeville, and dedication of the Trans-Sierra Highway. John G. Meyer, president of the Central Valley Subsection, may be seen at the extreme left, and R. Robinson Rowe (N. G. Neare to readers of "Civil Engineering") is leaning out of the window.



Rear Admiral Joseph F. Jelley, Jr., director of the Pacific Division of the Bureau of Yards and Docks and officer in charge of the Tenth Naval Construction Battalion with headquarters at Pearl Harbor, is guest of honor and principal speaker at a meeting of the University of Hawaii Student Chapter. Shown with him (left to right) are J. Gardner Bennett, professor of civil engineering at the university; Lt. J. M. Hill, aide to Admiral Jelley; Admiral Jelley; and Stanley Furukawa, president of the Chapter.

Coming Events

Arizona—All engineers banquet at the Westward Ho Hotel, Phoenix, February 24, during Engineers Week, at 6:30 p.m. Tickets at $5.00 per person may be obtained from John Zaffle. For further information write Remo Raniola, 4209 No. 15th Drive, Phoenix, Ariz.

Los Angeles—All day meeting of the Santa Barbara-Ventura Counties Branch at the U.S. Naval Research & Evaluation Laboratory, U.S. Naval Batallion Center, Port Hueneme, Calif., March 5. Program will include inspection of the new naval center.

Maryland—Student Program, joint dinner meeting of engineering students of Johns Hopkins University and the University of Maryland at the Engineers Club, Baltimore on March 9. Presentation of technical papers by students of both universities.

Metropolitan—Joint meeting of the Section and its Junior Branch at the Engineering Societies Building, 33 West 39th Street, Third Floor Auditorium, February 16 at 7:00 p.m.

Philadelphia—Winter social dinner with its Central Pennsylvania Subsection and Trenton Branch at the Engineers Club, Philadelphia, February 8 at 6:00 p.m. Presentation of Life Membership Certificates and movie.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Spokane Section—Evening meeting February 18.

Ten Student Chapter Conferences Planned

A number of regional Student Chapter Conferences are planned for the late winter and early spring. These will be in addition to the large West Coast conference scheduled for Friday, February 11, during the Society's San Diego Convention. Such conferences have proved interesting and valuable, not only because the students themselves plan, organize, and conduct the meetings, but also because they give men from different campuses an opportunity to get together on an informal basis and discover what other schools and students are doing.

Currently the Committee on Student Chapters is reviewing the set-up of all organized Chapter conferences with a view to improved grouping, especially for shorter travel distances. All suggestions will be welcomed by the Committee, which can be addressed through Society headquarters.

The following student conferences are scheduled.

Conference	Place	Date (Approximate)	Secretary	Address
Maryland-D.C.	Johns Hopkins	.....	.....	.....
Mid-Continent	Wash. U., St. Louis	Apr. 11, 18 or 25	Ted Duke	5644 Walsh St., St. Louis, Mo.
Midwestern	No. Dakota Agric.	.....	.....	.....
New England	U. of Mass.	Apr. 30	Kenneth K. Wilde Pete C. Wirth	C.E. Dept., U. of Mass., Amherst, Mass.
North Central	Mich. State Coll.	Mar. 30–Apr. 1	Harry Brassington	C.E. Dept., Mich. State College, E. Lansing, Mich.
Pacific Northwest	U. of Wash.	Apr. 21–23	Alexander Popoff, Jr.	C.E. Dept., U. of Washington, Seattle 5, Wash.
Phil.-Lehigh-Del.	Bucknell Univ.	Apr. 25	Richard Ulp	129 King St., Northcumberland, Pa.
Pacific Southwest	San Diego State	Feb. 10–11	Robert K. Fogg	4730 Palm Ave., La Mesa, Calif.
Virginia	.....	May 6	R. S. Rennicks	VMI Barracks, Lexington, Va.
Texas	Corpus Christi	Apr. 28–30	C. E. Woods	U. of Houston, Houston, Tex.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

National Highway Program

The outstanding event of the month to the engineering profession was the transmission to President Eisenhower of the report of General Clay's Committee on a National Highway Program. The controversial features of the report are being reviewed by the President prior to his presentation of the subject to Congress now scheduled for February 3.

The recommendations regarding reimbursement for expenditures made on existing and future toll roads which measure up to the required physical standards would permit such roads to play an important part in the program. The amount reimbursed may be applied to pay a state's share of other roads in its federal-aid system, thus expanding the total road construction possible for that state. This proposal is controversial. It is being fought by powerful organizations of highway users.

While the normal federal-aid programs of highway construction will be carried on as usual, the special emphasis is on the designated 40,000-mile Interstate System. The Federal Government would assume primary responsibility for this system at a cost of $25 billion spread over ten years, financed through the proposed Federal Highway Corporation. The state and local governments would contribute $2 billion. Commercial banks would be permitted to underwrite bonds, and a U.S. Treasury fund would be made available for loan to the corporation if needed to assure investors of their interest at all times.

Since this system would be built to very advanced standards and for estimated traffic of 1970, it is precisely this system which needs the greatest amount of fundamental engineering study and design. We must insist that full professional engineering thought be given to it.

Anticipating highway needs thirty years ahead is difficult. We must not permit a temporary shortage of engineers to result in a half-engineered program for the future, of which we might be ashamed when the future arrives. It is poor policy generally to try to effect saving of time or cost by cutting down on engineering.

Looming large among the administrative problems is the shortage of engineers with a suggestion that the services of consulting firms be utilized to the fullest extent. An enlargement of present research work is recommended.

The report of the Governors' Conference was also transmitted and referred to by General Clay in his report. It made recommendations parallel to and consistent with those contained in the Clay Report.

Highway Meetings

Three noteworthy meetings of highway experts took place during the month: the annual meeting of the Highway Research Board; National Conference on Highway Financing, sponsored by the U.S. Chamber of Commerce in Washington; and the Annual Convention of the American Road Builders Association in New Orleans. These meetings provided tentative answers to a few of the questions raised by the Clay Report. For further details see page 48.

Engineer Shortage

The program calls for the employment of a larger number of engineers than are now available.

Best quantitative information on the need for engineers of professional grade for the proposed gigantic highway program is found in a Technical Personnel Study presented at the Highway Research Board Meeting. This was based on figures submitted by all the State Highway Departments.

Present total of engineers employed by these Departments is about 18,000, while consulting firms do work that would require another 4,000. For maximum effectiveness the highway department feels they would need still another 4,000. Thus a total of 26,000 engineers is the estimated need for the 1954 volume of work, involving a capital outlay of $2\frac{1}{2}$ billion. Only five states reported no engineer shortage.

Land Acquisition

At the American Road Builders Association meeting the vital subjects of control of access and advance acquisition of land were ably discussed. The initiation of new legislation in the states and probably federal legislation to permit land to be acquired for needed roads is necessary immediately. The Highway Research Board is making a thorough study of the specific deficiencies in existing state laws which must be remedied to assure a successful highway program.

Other Public Works

While the highway program has stolen the spotlight, it is by no means the only new public works proposal. The President has proposed a school-building program, more public housing, reclamation and Army civil works projects. Public works will loom larger than ever before. These proposals will be discussed as they are presented as legislative measures for Congressional action.

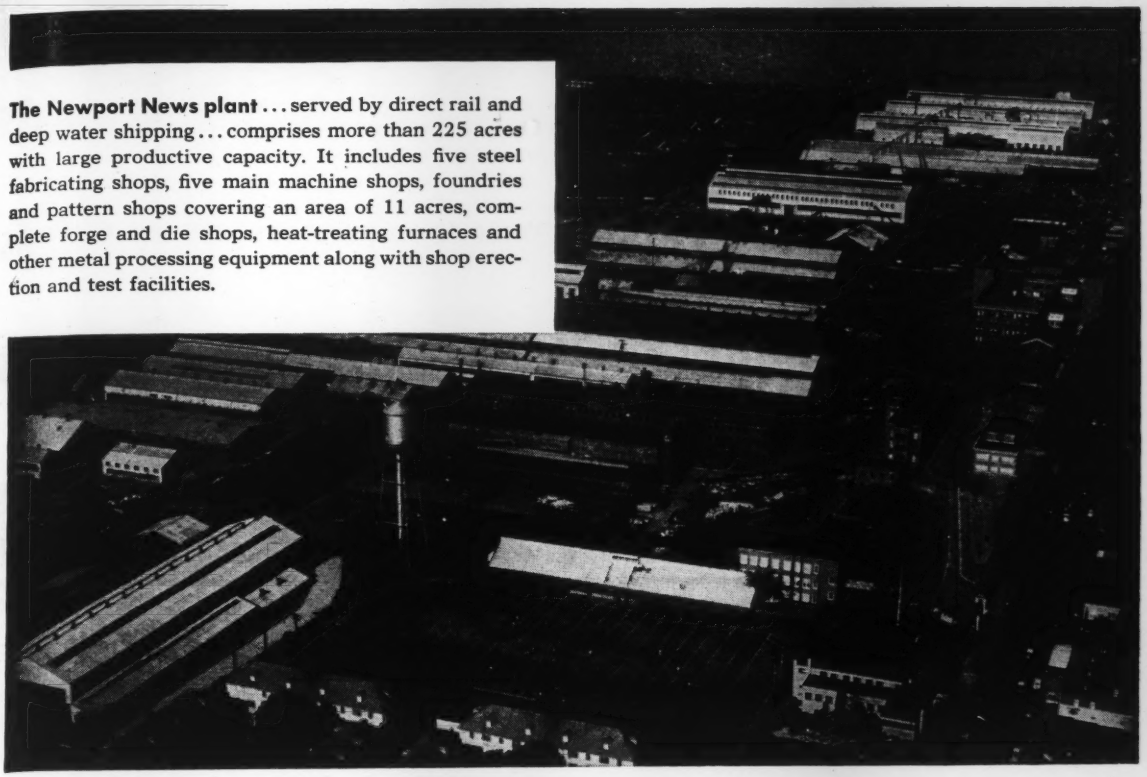
Federal Pay

The President has recommended a pay scheme for federal employees along the lines approved by the ASCE Board of Direction and presented to a committee of the last Congress by the Field Representative. It provides for fair raises in pay for the upper grades as well as the lower.

Roster of Sanitary Engineering Manpower

The Public Health Service is undertaking reestablishment of a national roster of professional sanitary engineers. The roster will be maintained by Assistant Surgeon General Mark D. Hollis, chief engineer of the Public Health Service, for possible use in event of major national emergency. This activity is being undertaken as one means of meeting emergency civil defense problems in the field of sanitary engineering.

Washington, D.C.
January 27, 1955



The Newport News plant ... served by direct rail and deep water shipping ... comprises more than 225 acres with large productive capacity. It includes five steel fabricating shops, five main machine shops, foundries and pattern shops covering an area of 11 acres, complete forge and die shops, heat-treating furnaces and other metal processing equipment along with shop erection and test facilities.

Make Newport News your source for fabricated metal structures

Let Newport News fabricate your weldments or sub-assemblies. Call on us for plate fabrication...from vacuum tanks to bridge caissons ... for pumps, valves, pipe lines ... you'll find that Newport News fabricates parts to answer most demands.

In the vast plant, shown above, Newport News craftsmen complete your orders with specialized production techniques, and with sound experience acquired through construction of thousands of products ranging from small components on rayon spinning machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee.

See for yourself what Newport News is doing, and how this company's high integration of skill and production facilities can help you. Get the facts, shown in *Facilities and Products.* A copy of this illustrated booklet is yours for the asking ... write for it now.

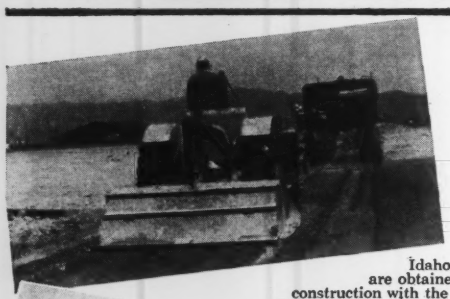
Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

HOW TO: slash base construction costs

. . . raise load-bearing standards

. . . save thousands of maintenance dollars

with the BIG NEW 1955 SEAMAN



Idaho. High densities are obtained in soil-cement construction with the SEAMAN Self-Propelled Mixer. Here the SEAMAN is mixing, blending and assembling aggregates and mixing in the water increment.

Compaction roller follows immediately behind SEAMAN TRAV-L-PLANT. The SEAMAN finishes to fine grade and crown leaving mix ready for final rolling.

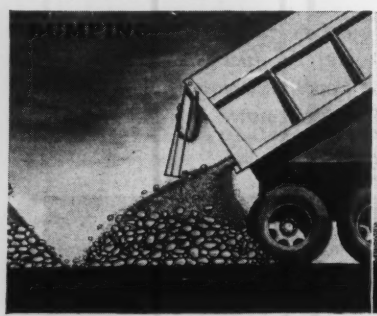
In every field of stabilization, with any material, any binder . . . whether for base, sub-base, shoulder or wear course . . . the SEAMAN MIXER —

SLASHES ORIGINAL CONSTRUCTION COSTS. The PULVI-MIXER attains a thoroughly blended and proportioned mix by the proper mechanical assembly of aggregates and fines, and does it in less time at higher daily output. Consequently the square yard cost for mixing and compaction is drastically cut.

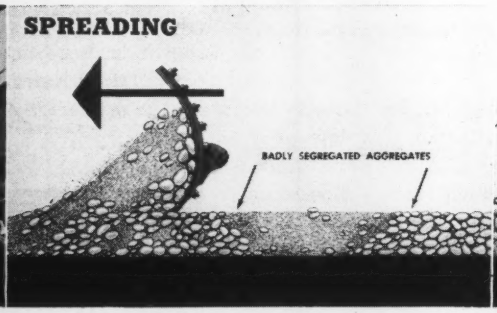
RAISES LOAD-BEARING STANDARDS. Because the PULVI-MIXER in its assembly of materials, keys and interlocks the aggregates and fills the voids with fines to securely mortar-in the larger stone, compaction produces a denser, more tightly knit course, which supports a much higher traffic load.

SECRET OF SEAMAN

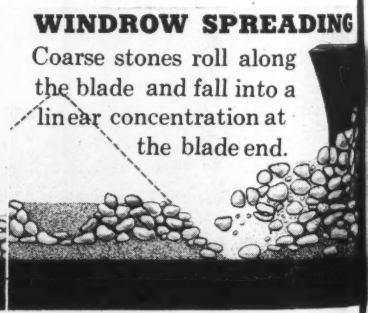
(below)



When gravel is dumped, it forms in piles. Larger stone falls first, the fines last. This segregated condition is highly unstable.



When those piles are leveled alternate pockets of fines and coarse are formed. A base so constructed will soon ravel and break up.



In spreading windrows to final grade fines are concentrated in the windrow "heart." Some fines remain as a pocket, others sift to the bottom. Such segregation also is very unstable.

with 51 improvements!

The SEAMAN Self-Propelled TRAV-L-PLANT. 7 ft. mixing width. Gasoline or diesel powered. Equipped with pump, tachometer assemblies, volumetric meter and spray bar for application of bitumens or water.

PULVI-MIXER

SAVES MAINTENANCE DOLLARS. Stones or aggregates of any size when mortar-locked by the SEAMAN-process are highly immovable, consequently resist moisture penetration and the ensuing damaging effect of traffic. This is true whether the course be simple gravel stabilization or of a higher type employing any of the many available binders. A SEAMAN constructed base or sub-base stands without spring break-up, without raveling, washboarding or maintenance requirement.

EARTH FILLS AND EARTH DAMS. Those same SEAMAN principles, — the elimination of voids, and the blending of soils produce densities in earthwork that range 95% to 100%. Very important is the inter-mixing of the various soil types found in fill material so that uniform reaction to moisture and compaction will result.

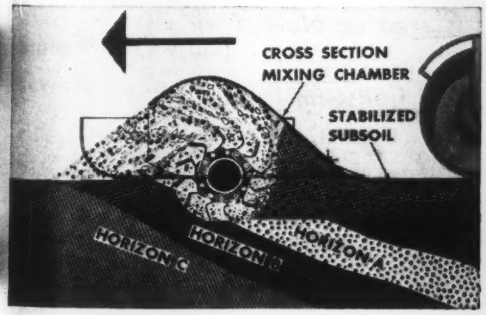
SEAMAN TRAV-L-PLANT in bituminous city street construction.

SEAMAN ANDWALL CORP.

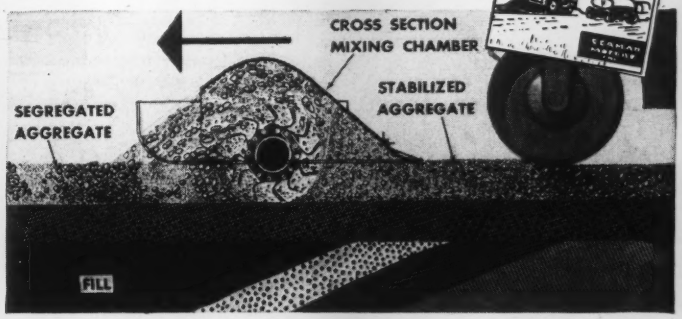
291 No. 25th St. • MILWAUKEE 3, WIS.

A description of the SEAMAN MIXER and the work it does is detailed in this recent BULLETIN. A postcard request will bring it to you — rush. Just ask for Bulletin TPS.

MIX STABILITY



Here the PULVI-MIXER stabilizes sub-base by blending soil horizons (A, B, C) to attain uniformity in moisture, density and thickness. This prevents sub-base failure.



Here the SEAMAN processes aggregate for the base, correcting by proper assembly of materials, an always-present segregated condition. The coarse material is keyed and interlocked, voids are filled with fines to securely mortar-in the larger aggregates.

NEWS BRIEFS . . .

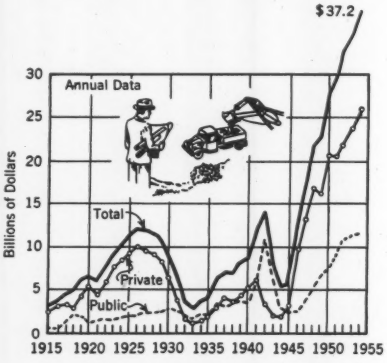
Construction Activity Sets New Record in 1954

A new record of $37.2 billion was established for construction activity in 1954 when outlays exceeded the 1953 peak in each of the twelve months, according to preliminary estimates prepared jointly by the U.S. Departments of Commerce and Labor. The total value of new work put in place was 5 percent above the 1953 figure, and made 1954 the eighth consecutive year in which construction activity reached a new high.

Outlays for new private construction ($25.7 billion) were up by 8 percent from 1953, topping the level for all previous years, even after adjustment for price changes. Public spending, at $11.5 billion, was virtually the same as a year earlier.

The major part of the increase from 1953 in total dollar outlays is attributed to the unusually high volume of private dwellings started last fall, which reflected increased supplies of funds for mortgage investment, as well as the liberalized mortgage loan provisions of the Housing Act of 1954. For 1954 as a whole, the value of work put in place on new private nonfarm housing totaled over $12 billion, also an all-time high. This compares with $10.6 billion in 1953, and $11.5 billion in 1950—the record-breaking year for the number of new dwelling units put under construction.

Other types of construction which showed unprecedented activity in 1954 were office buildings, shopping and service establishments, schools, churches, electric light and power facilities, water and sewer lines, and roads and highways. A backlog of need still exists for all these types of building, much of it in the many new communities that have arisen as a result of suburban development in recent years.



Construction expenditures for 1954, at $37.2 billion, are 5 percent above the 1953 figure and make it the eighth consecutive year in which construction activity reached a new high. Increase over recent years is shown here in Department of Commerce curves.

Private expenditures were greater in 1954 than in 1953 for all major types of construction except industrial plant, farm, railroad, and gas utilities. Although the increase for social and recreational building was substantial, the 1954 total was well under the 1949 peak. The 1954 gain in hospital construction reversed a downtrend that has continued since 1951. On the other hand, while private industrial building declined again last year from the 1952 high, the volume exceeded the $2 billion mark for the fourth consecutive year.

Decreases over the year in federal spending, especially for military facilities, were about offset by increased state and local government spending, mainly for schools, roads, and sewer and water systems. Federal outlays were also considerably less in 1954 than in 1953 for aircraft and ordnance production; testing, and research facilities; conservation and development work; and hospitals. Expenditures by state and local governments were greater over the year for all types of construction except public housing.

In the closing month of 1954, construction activity declined no more than usual for the time of year, with most types of construction remaining strong. December expenditures, totaling almost $3 billion, were down 9 percent from November, but were 10 percent above the December 1953 total.

First Steel Is Placed on New York's $35,000,000 Coliseum Project

An unusual erection procedure was employed on the New York Coliseum Project when this giant 30-ton steel truss was set in place 84 ft above ground, where it will stand for some time without benefit of horizontal frame bracing. Reason for this departure from the normal was that the portion of the building, which will finally act as horizontal bracing for the truss actually depends for its own support on the truss, and so cannot be built until after the truss is in place. The unit, 94 ft long and 21 ft deep, was the first of thirteen massive steel trusses to be erected as part of the structural steelwork for the $35,000,000 exposition and convention hall at Columbus Circle. Because of its size the truss was shipped in sections by rail from the Bethlehem Steel Company's Pottstown, Pa., works, and assembled at the construction site. The coliseum is being built by the Triborough Bridge and Tunnel Authority, with Walsh-Fuller-Slattery the general contractors. Jacob Feld, M. ASCE, New York consultant, is the design engineer.

Highway Research Board Holds 34th Annual Meeting

The wide scope of the Highway Research Board's thirty-fourth annual meeting, held in Washington, D.C., the week of January 10, is indicated by the fact that there were 38 separate sessions held all over the city. As usual the four-day program served as a clearing house for dissemination and discussion of all phases of highway research information. Among the subjects covered in the 186 papers and technical reports were materials and construction, design, economics and finance, traffic and operations, maintenance, soils, and night visibility. All the papers will be available later as Board publications.

Three of the country's top highway experts were honored at the opening session by presentation of the Roy W. Crum Award for Distinguished Service. They are Burton W. Marsh, M. ASCE, director of the Traffic Engineering and Safety Department of the American Automobile Association; Ralph A. Moyer, A.M. ASCE, research engineer and professor at the University of California's Institute of Transportation and Traffic Engineering; and the late Walter H. Root, M. ASCE, maintenance engineer for the Iowa State Highway Commission. All have been closely associated with the work of the Highway Research Board, which Mr. Root was serving as chairman at the time of his death last spring.

The Highway Research Board Award, which is made annually to the author of the best paper presented at the Board's last meeting, was conferred upon Claude A. Rothrock, M. ASCE, planning engineer for the West Virginia State Highway Department, for his paper, "Urban Congestion-Index Principles." The George S. Bartlett Award for "outstanding contribution to highway progress" went to James A. Anderson, M. ASCE, Virginia State Highway Commissioner. The Bartlett Award is made jointly by the Board, the AASHO, and the ARBA.

State Registration Laws Summarized

Information on the activities of the engineering registration boards in every state, the District of Columbia, Alaska, Hawaii, and Puerto Rico has been made available by the National Council of State Boards of Engineering Examiners. Prepared by the Council's Uniform Laws and Procedures Committee, the 120-page loose-leaf compilation is entitled "Synopsis of State Engineering Registration Laws and Policies and Procedures of State Boards." Copies, priced at $5 each, may be ordered from T. Keith Legaré, Executive Secretary of the NCSBEE, Palmetto State Life Building, Columbia, S.C.

Military Installation Built on Polar Ice Cap

The United States has constructed a unique military installation on the polar ice cap in Greenland. Built by the Army Corps of Engineers for the U.S. Air Force under the terms of a Danish-United States defense agreement, the project is the first designed and built for continuous use on the ice cap. It houses personnel of the Northeast Air Command, who man and operate the station, make weather observations, and collect other data concerning conditions on the ice cap. Overcoming construction problems caused by the snow and ice pack, which is nearly two miles deep in spots, the East Ocean Division of the Army Engineers employed the submarine "pressure-hull" principle and made the buildings of 18-ft tubes interconnected with passageways. The overall structure is balanced like a ship and designed to sink slowly on an even keel at the rate of several feet a year.

President's Message Calls for Water Resources Policy, More Highways, Public Works, Housing

Recommendations of wide interest to engineers highlight President Eisenhower's state-of-the-union message delivered to the Congress on January 4. Of special interest were recommendations for the adoption of a country-wide comprehensive water resources policy; for an expanded highway program; and for establishment of an office of coordinator of public works in the White House.

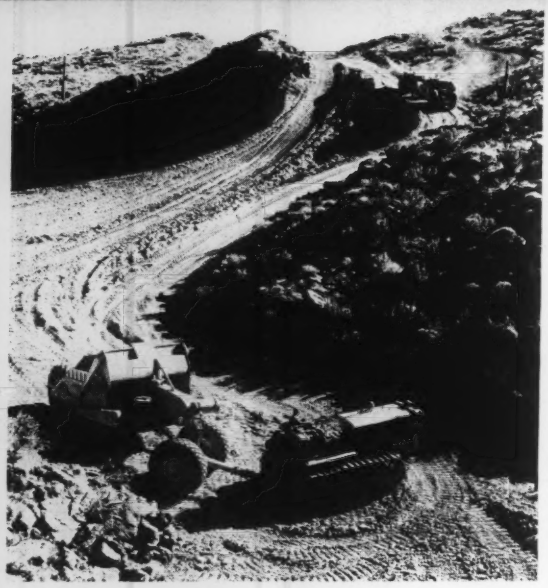
Urging approval of the $1,000,000,000 Upper Colorado River basin development project "to conserve and assure better use of precious water essential to the future of the West," the President said that, in addition, the 1956 budget will recommend appropriations to start six new reclamation projects and more than thirty new Corps of Engineers projects of varying size. "A great need in this broad field," he emphasized, "is a nationwide comprehensive water resources policy firmly based in law. Such a policy is under preparation and when completed will be submitted to the Congress for its consideration."

Pointing to the fact that it has been government policy to encourage local public bodies and private citizens to plan their own power sources, he noted that "Increasing numbers of applications to the Federal Power Commission to conduct surveys and prepare plans for power development are evidence of local response."

A modern highway system, President Eisenhower remarked, "is essential to meet the needs of our growing population, our expanding economy, and our national security. We are accelerating our highway improvement program under existing state and federal laws and authorizations. But this effort will not in itself assure our people an adequate system." He said that, aided by the findings of his special advisory committee (page 48) and the recommendations of the Governors' Conference, he will submit to Congress recommendations that "will meet our most pressing needs."

The need for a new housing program was also underscored. "As part of our efforts to provide decent, safe, and sanitary housing for low-income families," the message stated, "we must carry forward the housing program authorized during the past Congress. We must also authorize contracts for a firm program of 35,000 additional public housing units in each of the next two fiscal years. This program will meet the most pressing obligations of the federal government into the 1958 fiscal year for planning and building public housing."

The President emphasized that the efficient planning and execution of the nation's public works require the coordination of federal activities and effective cooperation with state and local governments, and said that to achieve this "essential coordination" he will request the Congress to appropriate funds for the establishment and support of an Office of Coordinator of Public Works in the Executive Office of the President.



ARBA
Appraises Road-Building Capacity of U.S. Industry

To supplement existing highway construction equipment, new machinery having a work potential of about $0.8 billion will be needed in the first expansion year of the vast road program. Greatest needs for new equipment will occur in the second and third expansion years.

Unalloyed enthusiasm best describes the attitude of the nation's road builders at the recent annual meeting of the American Road Builders' Association in New Orleans. Highway departments, long nourished on a bread-and-water diet of restrictive highway budgets, are now buzzing with a vision of the champagne days to come under the President's 101 billion-dollar road program. (Clay report, page 48.)

Retiring President Robert M. Reindollar epitomized the general attitude in his farewell remarks to the Association when he said "You have a most wonderful opportunity to render a great service to the country through forthright action at this time and the lending of your full advice and support to the problem of promotional, educational and coordinated effort which will be required to make the program an accomplished fact. This will mean full integration of the many problems which will arise between the four levels of government—federal, state, county and municipal—as well as with the toll road authorities. Let's pull together and put it across."

To demonstrate its intention of full cooperation, the ARBA has made an exhaustive, four-part study of the manpower, material and equipment needed to fulfill such an ambitious program. The study concludes that, with considerable expansion in some productive areas and more efficient use of engineering manpower, the road-building capacity is available.

The report of Task Force No. 1 on "Planning and Design" noted that, "from three to eighteen professional engineers are used per million dollars of construction work and that the average is about eight. Using an average of eight, the $4 billion current construction program requires some 32,000 professional engineers. However, if the engineering manpower requirement could be reduced to an average of four engineers per million dollars, double the work load, $8 billion per year, could be accomplished." To attract graduate engineers and subprofessional help into the highway field, it will be necessary to bring highway engineering salaries and other job benefits into line with the salaries and benefits in competitive fields. It further noted that although there are sufficient plans on hand for the first year's program, it will be necessary to start immediately if we are to have plans available for the subsequent nine years of the proposed program.

Little if any opposition was apparent in the comments of congressional leaders before the convention. Senator Dennis Chavez, D., New Mexico, incoming chairman of the Senate Public Works Committee, characterized the program as "ambitious and necessary." He went on to predict that Congress will support a reasonable administrative program that serves all the people. The senator emphasized that there has never been a minority report from the Public Works Committee under Democratic or Republican leadership, and he was certain that the approach to the road program and all public works would continue to be bipartisan.

Senator Case, R., South Dakota, minority leader of the Senate Public Works Committee, further emphasized the bipartisan attitude of the committee.

Representative Fallon, D., Maryland, incoming chairman of the House Subcommittee on Roads, although supporting the new program, sounded a note of caution when he said "as chairman of our Committee, I would welcome any sound plan to accelerate highway improvements but any such plan must provide for a balanced program. I fully support the urgency of bringing the Interstate System and its urban extensions up to required standards, but I would approach with caution any proposal that would jeopardize the principles of the Federal Aid Program."

In discussing the impact of the road program on the economy, Representative MacGregor, R., Ohio, minority leader of the House Committee on Roads pointed out, "The initiation of such a program as prepared by the President will give the construction industry an assurance it has long wanted and seldom had, that is, a long-range, soundly conceived highway and street program. They in turn can organize and perpetuate a smooth-running and efficient construction organization, with the well-equipped and always exceedingly expensive tools and machinery, as well as men, assured of a long-range program, sufficient to justify such an establishment and investment." He further emphasized one of the prime requisites for an adequate road-building team when he declared "We must be prepared with competent, technical and professional personnel, adequately compensated, to produce the necessary plans and specifications and to supervise the construction."

ARBA Task Committees Make Recommendations

Perhaps the most significant presentation made at the ARBA convention was the report of its four task committees on "An Evaluation of the Ability and Readiness of the Engineering Profession and the Highway Industry to Plan, Design and Execute a Program to Eliminate the $101 Billion Deficiencies in the Nation's Highways in a Period of Ten Years."

The investigations of the task group call for increasing the current 1954 annual highway program of $4 billion to $6 billion in the first year of a ten-year program; to $8 billion in the second year; to $10 billion in the third year; and to $11 billion in the fourth year and each of six successive years until the $101 billion goal is reached.

Abstracts of the conclusions of the task committees follow.

1. Planning and Design

While the total ten-year highway construction program will amount to $101

billion, only a portion of this, some $6 billion per year (excluding right-of-way and local road construction) will require extensive engineering. This is an increase of 140 percent over the current $2.5 billion rate.

The value of the backlog of highway construction plans wholly or partially complete amounts to more than $16 billion. The state and territorial highway authorities are planning $6 billion of work, the toll authorities over $9 billion, and the local authorities at least $1 billion.

Current information indicates that from 18 to 30 months are required to plan a major highway project. It is desirable, therefore, that advance planning be initiated immediately and that an effort be made to reduce the time required to plan highway construction.

While the availability of engineering personnel for the expanded highway program will be a major problem, it should be possible to obtain the professional engineering capacity by reassigning professional engineers to professional positions and by reducing engineering requirements through the use of standard and simplified plans and standard specifications. Additional engineering capacity can be obtained from other industries, by the increased use of consulting engineers, and by attracting at least half of the civil engineering graduates into the highway field. Although the sub-professional shortage will be more acute, it should also be possible to overcome that shortage by reducing engineering requirements through the use of modern location and design methods, by obtaining additional capacity from other construction fields, and by providing on-the-job training for the additional sub-professional help. The on-the-job training program should be developed now.

One of the major bottlenecks to the completion of the expanded program is the location of the interstate system. This system now consists of unlocated routes between widely separated control areas. The routes are now designated by the presently traveled highways between these areas. The establishment of exact routes, especially in urban areas, will be a time-consuming operation. An intense and concerted effort by all levels of authority to solve this problem is an immediate necessity.

Another problem that may hold up the expanded highway program is the lack of adequate access control laws. Some thirteen states have no access control laws and the laws in many other states are not fully adequate. Action is needed now to remedy this deficiency.

Additional laws are also needed to provide the authority for advance acquisition of right of way. Such legislation should be enacted without delay.

Bridge design should not be a serious problem. Greater use of prefabricated and standard bridges will reduce engineering. Cooperation between the designers and fabricators should reduce the drafting effort required on large structures. Efforts in this direction should be initiated.

Another impediment to the rapid completion of the expanded highway program is the lack of definite knowledge of the characteristics of future traffic. Speeds, weights, and sizes of future traffic determine design criteria. All interested segments of the nation's economy should therefore consult together and determine the characteristics of tomorrow's vehicle.

After careful study and deliberation, Task Force No. 1 on Planning and Design concludes that the engineering profession, with certain adjustments and expansions, is fully capable of satisfactorily handling the proposed program. Plans are now in readiness or in preparation for $16 billion of highway work. These plans should be completed as soon as possible, and additional planning should be undertaken immediately. In addition, action to remove the bottlenecks discussed herein and in the reports of the other task forces should be taken immediately. These actions will require the cooperation of all facets of the nation's economic life. The engineering membership of ARBA stands ready to assist in this endeavor.

[Hal G. Sours, M. ASCE, consulting engineer of Columbus, Ohio, was chairman of Task Force No. 1.]

2. Materials and Supplies

The maximum material use during the proposed ten-year highway construction program will occur during and subsequent to the fourth year. The maximum demand therefore would not have to be met before 1959 or 1960. During the ensuing period the demand will increase at a gradual rate. This will give industry an opportunity to plan and, if necessary, expand production for the peak requirements.

Portland cement is one of the basic highway construction materials. It might be in short supply, particularly in certain regions, if production is not expanded. The current highway construction use of 50 million barrels of portland cement (exclusive of precast products such as culverts) will increase to 161 million in the fourth year and remain at that level throughout the remainder of the program period. Regional requirements in the New York–New England area and in the Michigan, Illinois, Indiana, Kentucky, and Wisconsin area would consume the entire current cement-production capacity in these areas and leave no supply for other users.

Although some increase in production is possible from present plant facilities and new plants having a 20-million-barrel production capacity are now planned, an additional 80 million barrels of production capacity will be needed for the peak years if the consumption by non-highway users remains at present levels. Current indications are that the cement producers will increase production capacity to 407 million barrels per year by 1959. This would provide the cement necessary for the expanded highway program.

The production of aggregates could be increased to 324 million tons with relatively little expansion of existing facilities. Production at a higher rate will require the installation of additional equipment and the opening of additional quarries and pits. It is expected, however, that the equipment necessary for that expansion will be available and that the aggregate industry will expand to meet the anticipated requirements when a firm market is assured.

Present consumption of bituminous materials—asphalts, tars, and road oils—is estimated at 18 million tons per year. The expansion of the highway program will increase consumption by 7 million tons. Existing production facilities with only minor expansion could increase production by 17 million tons per year. This is more than ample for any possible highway program.

Basic steel supply is not a problem. The structural steel supply, except for a slight shortage in wide-flange structural shapes, will be ample as soon as the 600,000-ton plant expansion program now authorized is completed. The small shortage of wide-flange shapes will probably be overcome by additional expansion.

The use of reinforcing steel, especially paving reinforcing, will be increased materially. It is expected that the steel industry will be able to supply the reinforcing bar without difficulty by conversion of existing facilities. Considerable expansion will however be necessary in the wire-fabric, wire-mesh, and bar-mat areas. It is expected, however, that the steel industry will take the action necessary to meet the requirements as they become firm.

Steel-fabrication capacity amounts to some 3.5 million tons. Considering that other demands remain level, the peak requirement during the expanded highway program will amount to 4.9 million tons. Through increases in working hours, it should be possible to increase production to 5 million tons per year. This, with some expansion in areas where capacity is short, will be more than ample for the expanded highway program.

Production capacity is now available to meet the expanded requirements of both reinforced concrete and corrugated metal

John N. Robertson, director of highways for the District of Columbia, succeeds Robert M. Reindollar, Baltimore consultant, as president of the ARBA.

pipe. Some additional steam-curing equipment may be needed for concrete-pipe manufacture when the period of maximum requirements is reached. Regional shortages of portland cement and wire mesh might cause some curtailment in the manufacture of concrete pipe. However, the production capacity for both cement and wire mesh is being expanded and such delays, if they do occur, should be of short duration. No shortage is expected in sheet steel for corrugated metal pipe.

Traffic signs and markers and the all-important reflective materials needed in their manufacture will be in good supply.

Such highway construction materials and supplies as lumber, timber piling, petroleum products, explosives, paint, etc., are expected to be in good supply, and no difficulty is anticipated in providing for peak requirements.

[A. T. Goldbeck, M. ASCE, engineering director of the National Crushed Stone Association, Washington, D.C., is chairman of Task Force No. 2.]

3. Construction

In 1954 highway contractors operated at only 46.4 percent of productive capacity.

Contractors could support a maximum highway program of $7.4 billion in one year with present organizations and equipment without highway department delays enumerated herein.

Shortages of equipment operators would not be a serious problem because sufficient lead time would be available to train and to secure additional operators. In addition, other shortages, which appear in the estimates of manpower requirements, can readily be overcome through conversion to highway construction of contractors now engaged in other similar work. Training and greater supply of highway workers through population increases would supplement these sources.

Equipment available for highway construction either through contractors' inventories or by rental is estimated to have the necessary productive capacity for a $7.5 billion program. Additional equipment to meet the needs of higher annual program levels and for replacements could be made readily available through production expansions.

A larger highway construction program would foster proportionately greater productive capacity through more efficient utilization of equipment.

After a careful study of the factors involved, Task Force No. 3 concludes that the highway contracting industry as now organized and equipped, while only operating at a $4 billion level in 1954, is fully capable of satisfactorily operating at a $7.4 billion construction level, which is more capacity than required for the first expansion year. It is further concluded that through individual contractor expansion and the introduction of new capacity, including the transfer of additional capacity from other segments of the contracting industry, the "stepped-up" program, leveling off at $11 billion, can be efficiently and economically accomplished without adverse effect upon the construction industry as a whole.

[S. Howard Brown, president of Brown, Davis & White, Grantville, Pa., is chairman of Task Force No. 3.]

4. Construction Machinery and Equipment

The existing highway equipment aggregations owned or available to highway contractors are estimated to have an additional work potential of approximately $1.0 billion over and above the $3.1 billion volume of highway construction accomplished in 1954. This potential would raise the total construction level to $5.2 billion if present work patterns remain essentially the same. The 1954 contract construction volume could be more than doubled under maximum utilization of the entire work potential of contractors and their supporting equipment.

Nearly one-half of the $101 billion highway deficiencies are located in urban areas or on the limited mileage of the interstate system. Most of the proposed improvement work involves the elimination of bottlenecks on high traffic routes and undoubtedly will be given a high priority in any expanded construction program. Such a concentration of work would make better equipment utilization possible and reduce to some extent the overall equipment quantities required.

In view of the idle and expansible work potential of equipment now owned or available to highway contractors, additional equipment having an annual work potential of $0.8 billion would be sufficient to expand to a $6.0 billion construction level in the first expansion year from the present $4.0 billion level. This expansion would involve some 46,100 additional major units, including 28,100 units of construction machinery and 18,000 motor vehicles. The total requirements for the first expansion year, including replacements for the 1954 construction and maintenance levels, would involve approximately 126,300 units.

The maximum equipment requirements, including normal replacements and additions, occur in the second expansion year when an $8.0 billion construction level is reached by a $1.6 billion increase in contract construction volume over the previous year. The total requirements at this time are about 172,000 units, including 80,000 replacements and 92,000 additional units for fleet expansion.

Only a moderate fleet expansion is needed in the fourth year to bring the highway construction program to the $11.0 billion level by a $0.6 billion increase in contract construction volume over the previous year.

After the fourth expansion year, annual requirements will be largely of a replacement nature. However, this low point in equipment requirements will be compensated to some extent by the equipment repair parts requirements which will reach a maximum level beginning in the fifth program year.

Distributors' equipment inventories are now at a seasonal low. Manufacturing stocks, on the other hand, are high in most categories and will be used to build up the distributors' inventories during the next several months. Inventories are low for most items of concrete paving equipment and crushing and screening plants and off-highway hauling equipment.

The current rate of equipment manufacture by the construction machinery and allied equipment industry varies from 33 to 67 percent of peak capacity, depending on the product. The industry is, therefore, in a good position to expand production for an accelerated highway program.

In the event highway construction is expanded at the rate of $2.0 billion per year, shortages in certain equipment categories may develop, particularly in the second expansion year, after the additional work potential of existing equipment has been taken up. Such categories include contractor-type wheel tractors, off-highway hauling equipment (trucks, trailers and wagons), aggregate production machinery and paving equipment.

[Task Committee No. 4 was headed by F. W. Salditt, vice-president, Harnischfeger Corporation, Milwaukee, Wis.]

Rubber Streets Withstand Severe Winter Conditions

Recently opened to traffic in Rapid City, S. Dak., is one of the largest metropolitan rubber-type road resurfacing projects in the nation. Use of Rubarite—a free-flowing powder made of unvulcanized synthetic rubber and barytes mineral—was decided upon for ten of the major business streets after installation of a successful test patch last winter. Examination of the patch this spring revealed that 90 percent less cracking had developed than in the other city streets despite the customary extremely severe winter. For use on the Rapid City streets the Rubarite was mixed with asphalt and then spread to an average of $1\frac{1}{2}$ in. thick. Rubarite is produced at Magnet Cove, Ark., by Rubarite, Inc., which is owned jointly by the Goodyear Tire & Rubber Co., the National Lead Co., and Bird & Son, Inc.

Another San Francisco Bay Crossing Planned

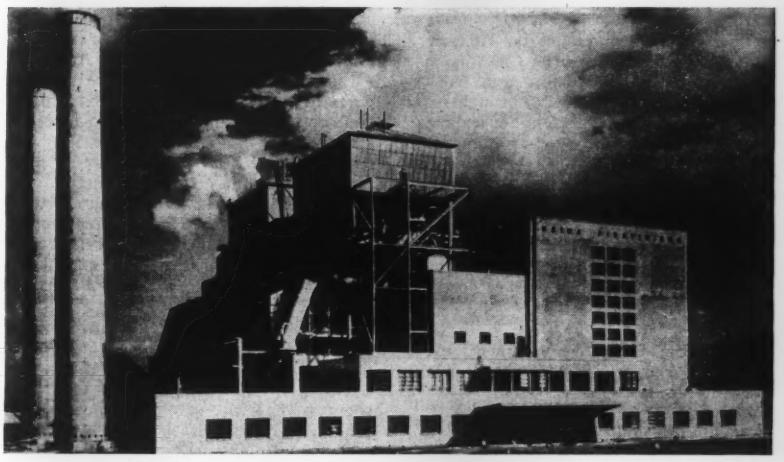
The long-discussed second crossing of San Francisco Bay may be put under construction by the middle of 1956 and may be in service by the end of 1961. This is the consensus of the California Department of Public Works, which reports a preliminary survey of the project based on details presented by Norman C. Raab, M. ASCE, engineer for the project.

Linking San Francisco with Alameda County, the proposed structure would cross the bay south of the present San Francisco–Oakland Bay Bridge, which now carries the bulk of the San Francisco-Alameda County traffic. At one time the state was planning to make the crossing a twin to the present bridge. Following the route plotted by the 1953 legislature, the projected structure would extend from Army Street, San Francisco, to Bay Farm Island, on the east side of the bay, with one road branching northward to Alameda and Oakland, the other southward.

The project would consist of 7.7 miles of viaduct and underwater tube and several miles of approaches. From San Francisco a low trestle, six-lane viaduct would extend a mile over the bay to a man-made sand island. There six traffic lanes would divide into three two-lane tubes, which would run under the bay for a mile. They would be located 50 ft under the ship channel. At a second man-made sand island traffic would be returned to the surface and taken over a viaduct almost four miles long. The tubes would be 200-ft-long prefabricated sections, which would be floated from drydock by barge and sunk in place.

Unofficial estimates put the cost at about $200,000,000 for the crossing itself and $100,000,000 for the approaches.

Brazil Opens 200,000-kw Steam-Electric Power Plant



The recently inaugurated Piratininga plant on the outskirts of Sao Paulo will help Brazil combat conditions resulting from the prolonged drought. With an output of 200,000 kw, it is the largest steam-electric plant ever built in Brazil. Designed by the Stone & Webster Engineering Corporation and built by the Stone & Webster Construction Company for the Sao Paulo Light and Power Company, the installation is of the semi-outdoors type, fueled by oil but easily convertible to coal if required. The two General Electric generator units, the largest ever transported to South America, were shipped to the port of Rio de Janeiro, and from there 250 miles by rail to Sao Paulo. The International Bank made a loan of $18,790,000 to the Brazilian Traction, Light and Power Company for the purchase of necessary foreign equipment.

Socony-Vacuum Building to Have Stainless Steel Skin

Stainless steel has been selected as the exterior sheathing for the 42-story Socony-Vacuum Building now under construction on East 42nd Street in New York. It will also be used for the 3,200 windows, which will pivot to permit cleaning from inside the building. More than 750,000 lb of stainless steel will be required for the structure, the largest metal-clad building in the world. Both the exterior sheathing and windows will be fabricated by the Truscon Steel Division of the Republic Steel Corporation.

Substantial weight saving will result from the use of the stainless steel sheathing, which weighs approximately 2 psf, as compared with 48 psf for a 4-in.-thick brick exterior wall. Other advantages of the covering are that it will take the embossed pattern selected for the panels without tearing or weakening, and that it does not require special coatings or treatment to withstand atmospheric corrosion. To meet the requirements of New York's building and fire codes, a 4-in.-thick masonry wall will back up the stainless steel skin with air space between.

Ground was broken for the building March 30, 1954. The construction time table calls for finishing the steelwork next spring, and completion of the project in the spring of 1956.

Edwards & Hjorth, of New York, are the structural engineers; Jaros, Baum & Bolles, the mechanical engineers; and Harrison & Abramovitz and John B. Peterkin, the associated architects. The general contractor is the Turner Construction Co., of New York.

AIChE Installs New Secretary

Franklin J. Van Antwerpen has been installed as secretary and executive secretary of the American Institute of Chemical Engineers. Previously director of the Institute's publications, Mr. Van Antwerpen will be administrative head of the Institute's activities in his new position. He is a graduate of Newark College of Engineering and has done graduate work at Columbia.

World Health Day Set for April 7

The importance of pure water to health is the theme chosen for this year's World Health Day, which will be observed April 7. Marking the anniversary of the activation of the constitution of the World Health Organization on April 7, 1948, World Health Day has been observed in most WHO member countries since that date. The theme for this year's program, "Clean Water Means Better Health," is intended to emphasize the organization's interest in health needs and to underscore a problem of major importance to health authorities in countries in all stages of sanitation development.

To aid health authorities in interesting the public in some phase of the health problem the WHO headquarters in Geneva has made available in limited supply an interesting program of articles and other material. Local Sections and similar groups may obtain this basic material for their use as is or adaptation for their celebrations of World Health Day.

Inquiries should be sent to H. G. Baity, M. ASCE, Director, Division of Environmental Sanitation, World Health Organization, Palais des Nations, Geneva, Switzerland.

Financing the President's $101 Billion Road Program

The National Conference on Highway Financing, sponsored by the Chamber of Commerce of the United States in Washington, D.C., January 13–14, brought together a distinguished group of experts in all phases of highway construction and use from all sections of the country. Using the Ten-Year National Highway Program prepared for President Eisenhower by the Clay Committee (see page 48) as a rallying point, the conference came to grips with the following questions about financing the $101 billion cost of the program:

Should the federal government take over the complete cost of modernizing the Interstate Highway System?

Should state and local governments be encouraged to finance and expand road programs through borrowing, and if so, how?

Should toll-road development receive federal coordination through financial aid where needed in the national interest?

Should federal automotive excise tax revenues from highway users be devoted to highway financing?

From what source should come the major share of additional highway construction money?

General Clay, in outlining his committee's report, pointed out to the Conference that the country is in the throes of a universal traffic jam. Safety demands that the improvement program get attention. The annual death toll on our highways exceeds 30,000. He concurred in the opinion that federal revenue from gasoline and excise taxes should be allocated to the program.

There was plenty of evidence that the report will not be unanimously accepted in all its details. For example, placing toll roads in the Interstate System came in for solid opposition from the American Automobile Association. The AAA supports the view that the $27 billion Interstate System should be built to incorporate turnpike standards but be entirely toll free. It fears that turnpikes built with toll money would continue perpetually as toll facilities. AAA also disagreed with the proposal that the Federal Government would reimburse the states that have constructed, or will construct, portions of the Interstate System to satisfactory standards as toll roads.

Although the Clay report presents a bold attack on the financing of 30 percent of the projected system—the Interstate System—speakers pointed out that it is silent on how the states will finance the remaining 70 percent.

By how much does the proposed program exceed the present rate of expenditure? It exceeds it by an additional $54 billion, of which $24 billion is to come from the Federal Government for the Interstate System, said Dr. Frederic H. Guild, Director of Research, Kansas Legislative Council. "This leaves for state and local responsibility approximately $30 billion, a staggering sum. Divide this $30 billion by 58,000,000, the estimated registration of privately owned motor vehicles in 1954. The result is $520 per car registered for the states and local governments to finance as their share in the program. Over a ten-year period, that is $52 per car per year." State and local governments do not face a simple problem, he said, but he believes they can assume the responsibility.

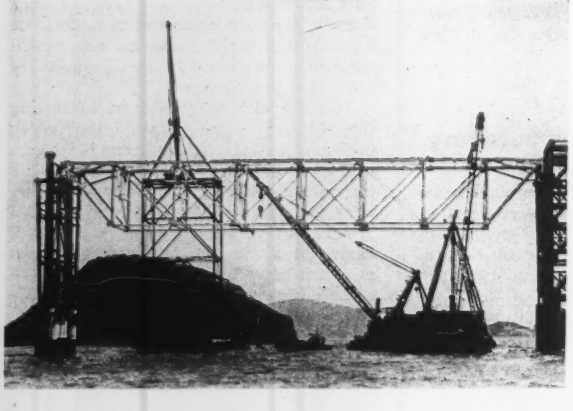
This view was echoed by Rex Whitton, M. ASCE, chief engineer of the Missouri State Highway Department. "I am a firm believer that at the state level the program should be kept on a pay-as-you-go basis... that such a plan will give the states far more for their money than any other." He is convinced that gasoline tax money should not be diverted to other uses. The continued leadership of the Bureau of Public Roads is needed, he feels, and for Interstate roads the "Federal Government should provide the funds but leave to the states the responsibility for designing and constructing them and for maintaining them after they are built."

Speaking out strongly in favor of financing and expediting construction of the Interstate System by private initiative, H. E. Bailey, general manager, Oklahoma Turnpike Authority, recommended that the Federal Government establish a national turnpike authority which would have the exclusive responsibility for the development of the interstate system. The authority would establish a standard toll of one to one and one-half cents per mile for passenger cars and two to four cents per mile for trucks. The federal participation would be from the excise tax it collects on autos, trucks, tires and tubes, and small parts. He recommends repeal of the federal gasoline tax leaving that source of revenue to the states. "I do not advocate the Federal Government going in debt to pay for the Interstate System," he emphasized.

In support of toll-revenue bonds for financing, Robert C. Oley, general manager, Bond Department, the Prudential Insurance Company of America, concluded that the method should be considered to such extent as it can be used conservatively. "It has been demonstrated that large segments of the driving public are perfectly willing to pay a toll for the comfort and savings in time and expense that are derived from being able to drive long distances in freely moving traffic without the inconvenience of innumerable traffic lights and grade crossings. Where the toll medium can be used the credit of the several states may be conserved for other pressing purposes. It would seem that here is our opportunity, at least in some part, to turn what is now a liability into a revenue-producing asset."

There was general agreement that the $101 billion program is staggering in both amount and implication. However the Clay report does present a rallying point for those who must seek a solution to a pressing national problem.

Aluminum Falsework Aids Erection of San Francisco Bay Bridge



Reduced costs in steel erection for the Richmond–San Rafael Bridge over the north arm of San Francisco Bay are permitted by the use of two scaffold-like aluminum erection-truss units, said to be the first aluminum application of its kind in the United States. Use of the aluminum falsework brings the cost of steel erection to about $8 per ton compared to a high of $70 per ton when steel falsework is employed. Used in construction of high-elevation steel spans for a portion of the superstructure of the four-mile-long bridge, each of the giant units is 280 ft long and can support in excess of 400 tons of steel. The Aluminum Company of America furnished aluminum alloy shapes and plate for the trusses, which were fabricated and erected by Judson Pacific Murphy–Kiewit, the construction company. Consulting engineers for the construction company were Earl & Wright.

NUCLEAR NOTES

IX—Measurement of Radioactivity (Part I)

This installment of "Nuclear Notes" was prepared at the request of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy by Morton I. Goldman, J.M. ASCE, Senior Assistant Sanitary Engineer, Robert A. Taft Sanitary Engineering Center, USPHS, assigned to the Oak Ridge National Laboratory, Oak Ridge, Tenn. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which also includes S. T. Barker, A. E. Gorman, Prof. Warren J. Kaufman, and James G. Terrill, Jr. Next month's subject will be "Measurement of Radioactivity" (Part 2).

In the fourth installment of this series (August issue, page 86) the nuclear particles and rays emitted by radioactive materials were discussed. The detection of these radiations requires the use of instruments, since none of the human senses is receptive to nuclear radiations as the ear is to sound, or the eye to light. There are many types of detection instruments designed for specific applications of radiation measurement, but all such devices in general use are based on one phenomenon—the ability of most nuclear radiations to cause ionization. The medium in which the ionization takes place and the means used to measure this ionization determine the type of instrument, but all utilize this one radiation characteristic.

Radiation-measuring instruments have developed from the visual observation of an indication on fluorescent screens and of relative darkening of photographic emulsions to extremely sensitive instruments capable of detecting single beta particles, or of indicating how many particles or rays of discrete energies are being emitted by a particular sample. Although the operation of the most complex measuring instruments is a difficult and sensitive task, the instruments in routine use are no more difficult to operate than a radio.

Radiation instruments may be classified in several ways—according to function (laboratory evaluation, area surveying, or personnel monitoring), or according to the principles involved in the operation of a particular instrument (ionization chamber, Geiger-Mueller counter, scintillation counter, etc.). Perhaps the most logical approach is to describe the instrument types on the basis of modes of operation, and then to indicate the application of these instruments to particular functions.

There are four principal media in which ionization produced by radiation is measured. The first, and most widely used, is an enclosed gas volume under an impressed electrical potential difference. Ions formed from the gas molecules by the interaction with radiation are drawn to the oppositely changed electrodes within the gas volume, and the passage of the negative ions (electrons) through external circuits provides the indication of radiation.

There are three potential regions in which such gas ionization instruments may operate. The first, requiring the lowest voltage, is called the ionization chamber region. In this region, the impressed potential is only sufficient to collect all the electrons produced by the radiation, providing a relatively true indication of the ionization capacity of the particular radiation. Dry air under a potential difference of about 150 to 250 v is most commonly used. The second region is called the proportional region and requires a higher potential gradient. In this region of operation, the electrons produced by the action of the radiation are accelerated towards the anode sufficiently to cause further ionization of gas molecules along their path. This action results in a pulse of electron flow which is proportional to the number of primary ions formed. Since the number of primary ions formed per ionizing particle is mainly a function of specific ionization (August issue, page 86), the amplified electron pulse will distinguish between an alpha or beta particle as its precursor. Proportional counters are primarily useful for their ability to discriminate between types of radiation—protons, alphas, betas, etc.—and operate at voltages from 500 to 5,000 v, depending on the filling gas (argon or methane or a mixture) and the physical dimensions of the chambers. The third region of operation of gas instruments is perhaps the most familiar, the Geiger-Mueller (G-M) region. This region requires still higher applied potential gradient across the gas, and the acceleration of the electrons by the field is sufficiently great to enable them to produce a veritable avalanche of secondary electrons to the anode. These electrons (as many as 10^9 may be produced by a single initiating electron) provided a single massive pulse at the anode which, as in the previous types, is passed through external circuitry to provide the indication of radiation. In a properly constructed G-M Counter all electron pulses are of the same magnitude regardless of the specific ionization or energy delivered by the primary ion. The extreme sensitivity of the G-M counter is its major advantage. These counters ordinarily operate between 700 and 2,000 v, depending upon the filling gas (argon or helium), its pressure, and the physical size of the central wire and chamber, etc.

The measurement of neutrons provides a special problem since these particles are not directly ionizing. Their presence can be indicated by using some of the nuclear reactions similar to those presented in the seventh installment (November issue, page 82) to produce the ionizing particles. The reaction most frequently used is the $B^{10}(n,\alpha)$ reaction which produces a highly ionizing alpha particle readily measured in gas ionization instruments. The boron

Traveling Steel Forms for Lining Waldo Tunnel

These traveling steel forms, fabricated by the Blaw-Knox Co., Pittsburgh, for lining the Waldo Tunnel are self supported and among the widest ever built—46 ft 6 in. The height is 28 ft 8 in. Built parallel to the old Waldo Tunnel, the new four-mile structure will accommodate three lanes of northbound traffic on Route 101 through Marin County, California. The existing Waldo Tunnel will be converted to inbound lanes. Although the tunnel is nearing completion, it will not be in service until the connecting roadway is paved. The Guy F. Atkinson Co., of San Francisco, is the contractor.

may be applied as a wall coating or as a filling gas, BF_3. Fast neutrons may be measured by their interaction with hydrogen nuclei to create "recoil" protons, which are also densely ionizing particles. Paraffin-wall chambers are generally used for detection of these fast particles.

The second medium used for radiation detection purposes is the photographic emulsion. This is listed as second primarily because of its historical significance, since it was through the accidental darkening of a photographic plate by uranium ore that natural radioactivity was discovered by Becquerel in 1896. The greater the exposure to radiation, the darker the film becomes upon development. By comparing the density (or opacity) of a film with the density of a film exposed to a known quantity and quality of radiation, an indication of the absorbed dose can be obtained. The major use of film in the detection of radiation at present is in the field of medical and industrial radiography. Films are also used for monitoring of personnel exposed to radiation. Another use of film in measurement is in the technique of autoradiography, where radiations from isotopes contained within the subject "take their own picture," instead of using an external source of radiation as in conventional radiography.

The third medium for radiation detection is the scintillation phosphor. A phosphor is a substance which responds to external stimulation by emitting visible or near-visible light. So-called "black-light" instrument dials and signs are examples of this phenomenon as are the substances in radium-dial watches. In the case of the watch dial, the alpha particles from the radium strike the phosphorescent compound and cause it to emit light. Scintillation detectors operate in much the same way, with the important addition of a light-sensitive electronic tube, the photomultiplier which detects the individual flashes of light and converts them to electrical current pulses. Scintillation counters may use any of several sensitive phosphors, depending upon the radiation to be detected. Silver-activated zinc sulfide is widely used for alpha detection; anthracene or naphthalene for beta detection; and sodium iodide crystals (with a "planted" thallium impurity) for gamma detection. Since the detection of radiation depends upon its absorption in a particular medium, sodium iodide crystals are much more sensitive to gamma radiation than the most sensitive of the gas ionization instruments whose filling gases are considerably less dense, and hence less absorptive of gamma radiation. This particular phosphor provides the major application of scintillation instruments at present; that is, as gamma detectors.

The final medium commonly used for radiation measurement is a chemical system which indicates the presence of radiation by a change in its chemical characteristics, such as pH, state of oxidation, etc. These indicators require massive amounts of radiation to be activated and are usually not sensitive to levels below about 25 roentgens (r). They are based on the disruption of chemical bonds by the radiation, with the ions formed recombining in new compounds to change the pH, etc. A typical system is the chloroform-water system which is widely used in civil defense personnel monitors. In this system, absorption of radiation increases the free hydrogen ion concentration which reduces the pH and changes the color of a pH indicator (brom cresol purple) when a predetermined dose of radiation has been absorbed; the level of which the color change occurs being set by the relative proportions of water and chloroform.

N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"This being the fifteenth anniversary of the founding of our Engineers Club, let's be charitable tonight and help Joe Kerr with the sequel problem of the floating wedge."

"I don't need help or charity, Professor. Remember, I kept the book, and wouldn't even tell Cal Klater the name of it."

"Method of Least Work for Morons, probably," jeered Cal, "or the Love Life of Isosceles Triangles!"

"The latter is close," admitted Joe, "because our wedge with an isosceles section floated with its vertex awash. Having learned from the book that the coordinates of the centroid of a triangle are means of coordinates of its vertices, and that the centroid of the submarine section was the center of buoyancy and had to lie directly under the centroid of the whole section, I put

$$\frac{1}{3}(x_a + x_b + x_c) = \frac{1}{3}(x_a + x_e + x_c)$$

to equate the abscissae of the two centroids. I deduced first that $x_b = x_e$, then that the base $\overline{BC}$ was vertical, next that the median was horizontal, and finally that the specific gravity of the wedge was 0.5."

"Stupendous," said Cal.

"Thanks," hissed Joe. "Now knowing that the wedge weighed 32 lb per cu ft, was 3 ft long, that $\overline{AB} = \overline{AC} = 18$ in., and letting the unknown base $\overline{BC} = b$, the required weight is

$$W = \frac{b}{6}\sqrt{1296 - b^2} \quad . \quad . \quad . \quad (1)$$

Since b had to be an integer, a few trials found the maximum $W = 108$ lb for $b = 25$ in."

"I'll bet you couldn't float it with its vertex awash," challenged Cal. "The book should have told you about the bees and the flowers and metacenters. Floating bodies tip over unless the metacenter is above the centroid. *My* book gives a handy formula for altitude of metacenter above center of buoyancy,

$$\overline{MF} = m = ew^3/12S. \quad . \quad . \quad . \quad (2)$$

where w is the width of the section at water line and S is the submerged area AEC. To make $\overline{MF}$ greater than $\overline{GF}$,

$$\frac{w^3}{12 \cdot {}^1/_4 bw} > \frac{b}{6}$$

which reduces to $b < \sqrt{432} = 20.78$.

"Joe overlooked 2 other conditions: the wedge can float with vertex straight up or straight down. For either position, Eq. 2 gives $m = b^2\sqrt{2}/12w$, which must exceed $\overline{GF} = \frac{w}{3}(2 - \sqrt{2})$. The inequality reduces to $b > 18\sqrt{4 - 2\sqrt{2}} = 19.48$. The only integer between these two limits is $b = 20$; then Joe's Eq. 1 gives $W = 99.78$ lb."

"And I'm glad," said Professor Neare, "that you wound up by using Joe's contribution. He tried so hard and found an unwanted but interesting maximum, forgetting the narrow margin of stability that makes triangular flotsam roll in a turbulent sea.

"Now, with an optimum of non-sequitur, I want to tell you about Toots Schultz who teaches calculus and structural analysis at Esseyeville Grammer School. Last Christmas, she was rebuked for asking each of her boy pupils to buy a 10-cent present for each younger boy, and each girl one for each younger girl, not realizing that the total cost would be between $200 and $300. So this month she is asking each boy to make a valentine for each younger girl and each girl to make one for each younger boy, at no cost altho there will be as many valentines as there were presents. How many pupils has Toots?"

[*Cal Klaters were: Ed C. Holt, Jr., Richard Jenney, Stoop (John L.) Nagle, Henry W. Troelsch and Rudolph W. Meyer.*]

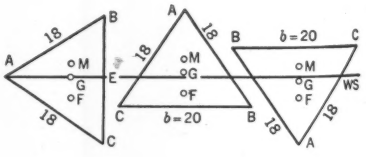


Fig. 1. For stability with vertex A awash, up, or down, metacenter M had to be above centroid G.

Under toughest conditions of dust, heat, cold... this transit

Keeps its Bearings!

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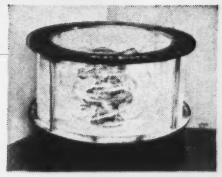

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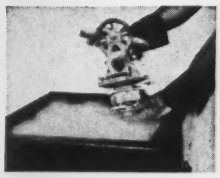

Temperatures from —70° to 160°F! Exposed to punishing extremes of temperature, Brunson instruments move freely in "arctic" cold or "desert" heat.

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DECEASED

Arthur P. Ackerman (A.M. '16), age 70, on the engineering staff of Clinton L. Bogart, New York City, since 1944, died on November 13. A graduate of New York University, class of 1908, Mr. Ackerman started his career with the 22nd Regiment of Engineers. Later he worked for James H. Fuertes as resident and assistant engineer, and from 1922 to 1932, was in the engineer's office of Hackensack, N.J., as chief assistant on design and construction of sewers. Later he was with the PWA in Washington, Newark and New York.

Walter Root Armstrong (M. '05), age 85, retired railroad engineer, died in Santa Venetia, Calif., on October 29. An 1890 graduate of Kansas State University, Mr. Armstrong spent 47 years in railroad work—in the engineering and operating departments. During this long period he was associated with the Kansas City Southern Railway Co., the Union Pacific, the Oregon Short Line Railroad, the Salt Lake and Utah Railroad and other lines. He retired in 1936.

William Sibson Bake (M. '43), age 72, general real estate agent for the Pere Marquette Railway, Detroit, Mich., died on June 28. Before joining the Pere Marquette in 1911, Mr. Bake worked for the Southern Railway, the Pennsylvania, and the Cleveland & Pittsburgh. With the Pere Marquette he served as assistant and division engineer, as land and tax agent, and since 1932 as general real estate agent.

William Joshua Barney (M. '27), age 70, chairman of the board of the W. J. Barney Corporation, New York, died in that city on December 12. After graduating from the University of the South, Sewanee, Tenn., in 1910, Mr. Barney was appointed Deputy Commissioner of Docks in New York City. From 1913 to 1917, he was consulting engineer for the Waterfront Terminal of Portland, Oreg. In the latter year he founded and became president of the W. J. Barney Corporation, which specializes in industrial construction. Prominent in the Society's Technical Division work, Mr. Barney was at one time chairman of the Construction Division. He had also been active in the AGC and the Building Trades Employers Association and was treasurer of the New York Building Congress.

W. J. Barney

John Cleaveland Beebe (M. '35), age 68, of Rathdrum, Idaho, died on December 13. Mr. Beebe received his B.S. from

(*Continued on page 94*)

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1954 — Roll-out of America's first jet transport, the Boeing 707

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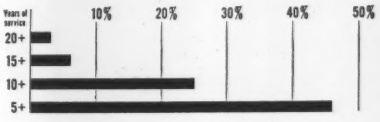

Here are other advantages: Boeing promotes from within and holds regular merit reviews to assure individual recognition. Engineers are encouraged to take graduate studies while working and are reimbursed for all tuition expenses. Of technical graduates at Boeing, 28% hold Mechanical Engineering degrees, 24% Electrical, 19% Aeronautical, and 9% Civil. The remainder is comprised of other engineering graduates, physicists and mathematicians.

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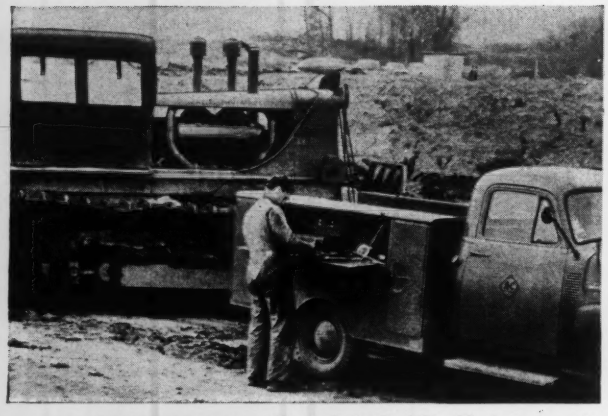

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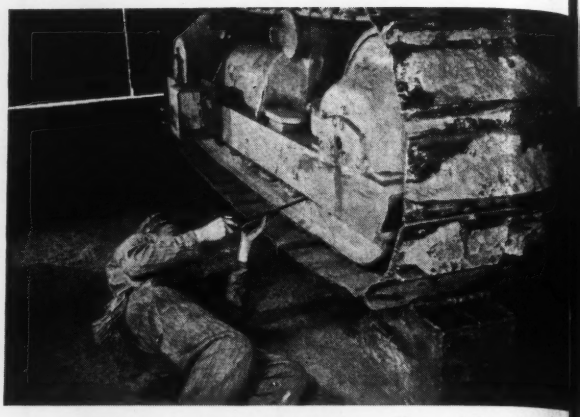

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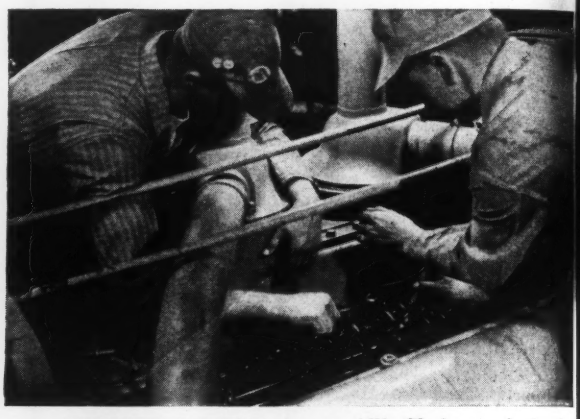

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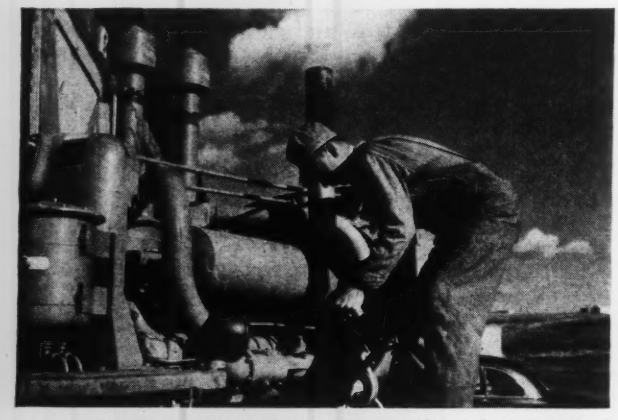

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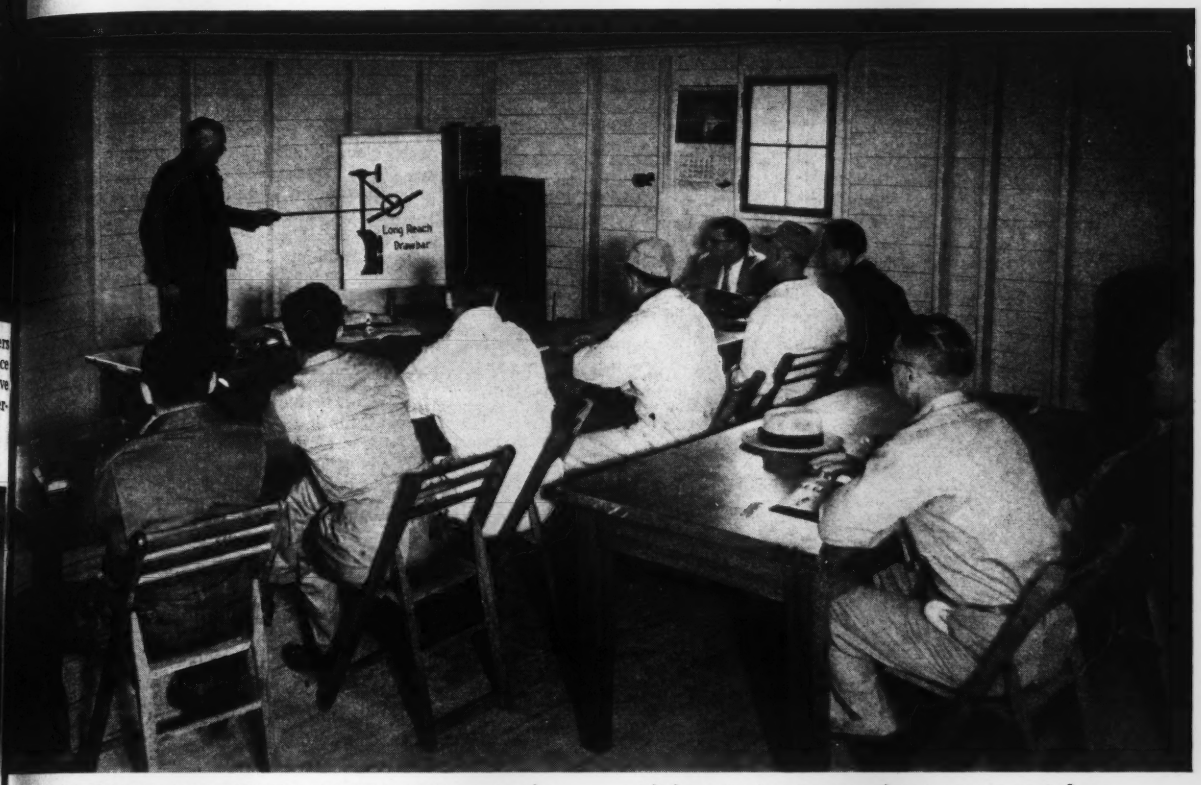

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Deceased

(*Continued from page 90*)

Dartmouth and the C.E. degree from the University of Wisconsin in 1910. He then worked on many private and government irrigation and power projects. From 1929 to 1939 he was with the U. S. Forest Service at San Francisco as senior civil engineer and assistant regional forester. In the latter year he started work for the Federal Power Commission in Washington as chief of the power flood control surveys division. Mr. Beebe, who retired recently, was scheduled to take office as county surveyor of Spokane, Wash., in January.

Albert S. Blank (M. '29), age 61, since 1933 property inspector for the Philadelphia branch of the Prudential Insurance Co., died on November 3. Mr. Blank received his C. E. degree from Lehigh University in 1915. He was employed in Pittsburgh and later worked on the design and construction of a sewer, water and road system for Belleville, N.J. Mr. Blank wrote numerous technical publications.

Edwin W. Buxton (M. '20), age 70, of Martinez, Calif., died on November 9. Mr. Buxton began his career with the Bureau of Lands in Manila after his graduation from the University of Illinois in 1907. In 1918 he became resident engineer for Waddell & Son and later joined the Shell Oil Co.'s office in Martinez as civil engineer. Upon his retirement in 1945, he became building inspector for the City of Martinez.

John W. Cleland (A.M. '22), age 68, retired engineer of the Southern California Gas Co., Los Angeles, died in October. Mr. Cleland joined the company in 1911, and in 1917 was made assistant chief engineer in charge of the engineering and statistical departments. He later became civil engineer, the position he held at the time of his retirement.

William Carey Cram, Jr. (A.M. '15), age 73, of Atlanta, Ga., died on November 29. Mr. Cram graduated from West Chester Teachers College and did graduate work at Lehigh University. From 1920 to 1926 he was vice-president in charge of engineering management of R. B. Wolf Co. of New York City. In 1927 Mr. Cram left New York to become construction manager of the Georgia Power Company in Atlanta. During the war he was manager of the Division of Contract Distribution, Office of Production Management.

Gordon Floyd Daggett (M. '24), age 65, design engineer for the Smith Engineering Works of Milwaukee, died on November 1. Mr. Daggett received B.S. and C.E. degrees from the University of Wisconsin. From 1913 until 1926 he was employed by the Wisconsin State Highway Commission and then was executive secretary and consulting engineer to the Wisconsin Mineral Aggregate Association. Before the war he was inspector for the National Park Service and after the war joined the Smith Engineering Works.

Allen Stewart Davison (A.M. '16), age 70, president of the Green Bag Cement Company of West Virginia, Pittsburgh, Pa., died on December 3. A graduate of Rensselaer Polytechnic Institute, Mr. Davison was secretary-treasurer of the Allen S. Davison Co. and then engineer. In the thirties he and his father founded the Davison Coke and Iron Co. which later became the Pittsburgh Coke & Chemical Co. Before the war he was treasurer of the Allen S. Davison Co., and in the forties became president of the Green Bag Cement Co.

Joshua D'Esposito (M. '26), age 76, of Evanston, Ill., died on November 16. Mr. D'Esposito was long employed by the Chicago Union Station Co., where he started in 1914 as assistant chief engineer. He later became chief engineer and finally acting general manager. In the thirties he started a private practice, and later was state engineer and project engineer for the PWA. More recently he had a private practice.

Richard Charles French (M. '49), age 48, sanitary civil engineer for the New York Department of Public Works, died on December 5. A 1927 graduate of the Cooper Union Institute of Technology, Mr. French began a long association with

(*Continued on page 96*)

"They tilted 30,000 tons of concrete..."

This unique ore-loading wharf designed in Plastiment-concrete by Frederic R. Harris, Inc., Consulting Engineers of New York, for the Aluminum Company of Canada's gigantic Kitimat project, was cast on its side, floated into place and tilted 90° into final position.

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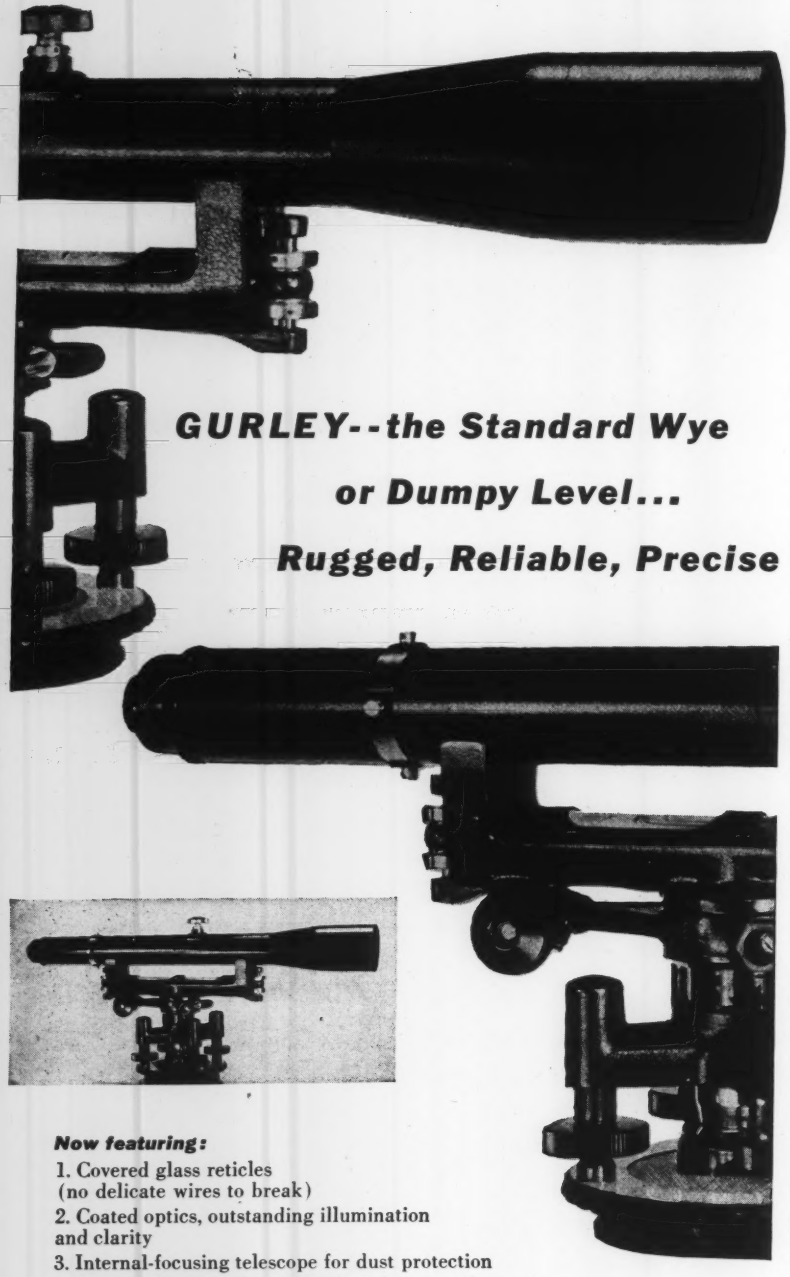

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Deceased

(Continued from page 94)

the New York City Sanitation Department in 1927. During this period he supervised equipment installation and helped start the Coney Island, Tallmans Island, and Bowery Bay sewage plants.

Louis Mathew Gerhardt (M. '42), age 54, structural engineer and project coordinator for the Eastman Kodak Co. of Rochester, N.Y., died on November 10. Mr. Gerhardt worked from 1922 to 1928 for the General Electric Company at Pittsfield, Mass., and later he was assistant engineer in the New York State Department of Public Works. From 1930 until his death Mr. Gerhardt was employed by Eastman Kodak as construction engineer and designer.

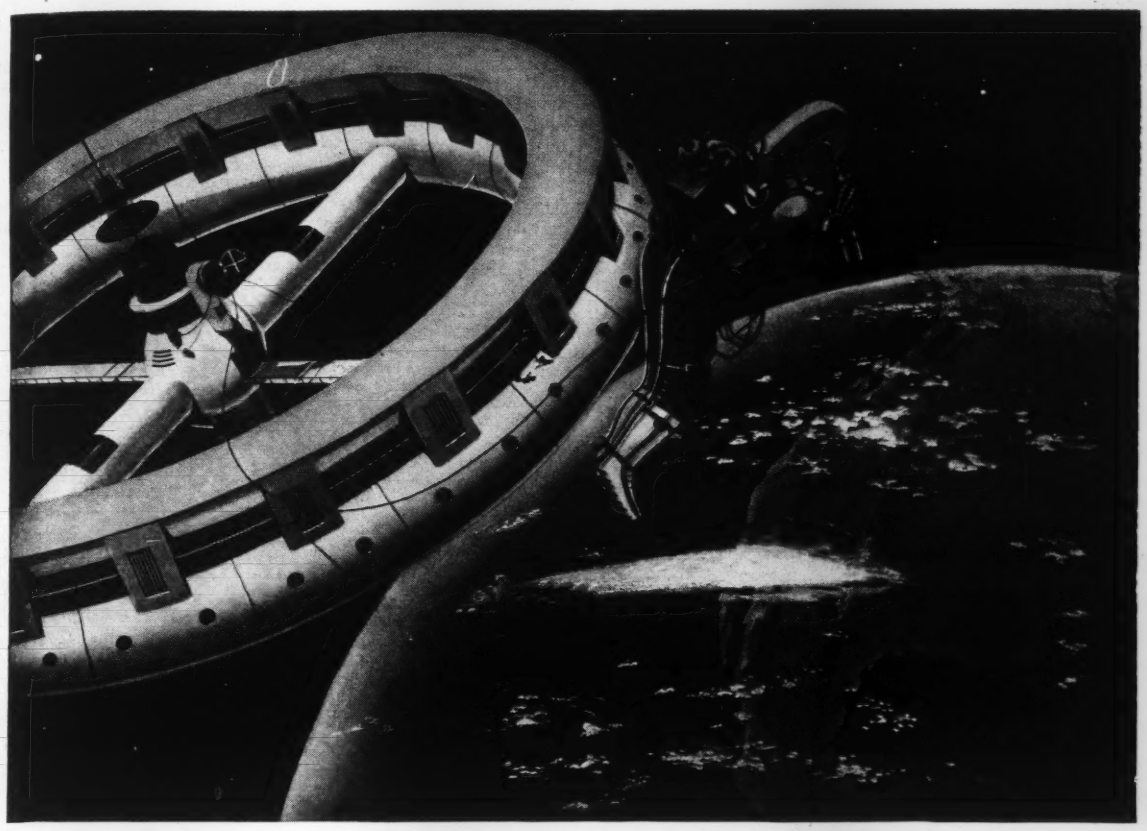
Harry Griffith Hunter (M. '21), age 66, who has worked for the General Services Administration since 1936, died on November 4. His home was at Chevy Chase, Md. Mr. Hunter graduated from the University of Missouri in 1909 and then started work with Harrington Howard & Ash (later Waddell & Harrington). In 1926 he left there to become chief engineer for the Atlanta Bridge Company, and from 1933 to 1936 he was special engineering adviser for the Reconstruction Finance Corporation. After 1936 Mr. Hunter held various positions in the Public Buildings Administration and its predecessor organizations. In 1942 he was made assistant commissioner and in 1949 became deputy commissioner.

William Samuel Jennings (M. '51), age 54, of Chester, Va., died on October 31. Mr. Jennings began his career with the Indiana State Highway Commission in 1928, and in 1939 became structural engineer and specification engineer for the Indiana Department of Conservation. He was employed by the Allied Chemical & Dye Company at Chester from 1941 until his death except for an interval during the war in the Navy Bureau of Yards and Docks. In the company he was designer in the Solvay Process Division, becoming supervisor of civil engineering work for the developmental division in 1951.

Walter Johannessen (M. '37), age 63, senior partner in the firm of Johannessen and Girand, Phoenix, Ariz., died on November 14. Following his graduation from George Washington University in 1916, Mr. Johannessen worked for eleven years for various railroad and mining companies. In 1927 he joined the city engineer's office in Phoenix, and later became assistant city engineer. Before the war he was traveling engineer for the PWA. He founded the firm of Johannessen and Girand at the end of the war.

Charles Joseph Kaltenbach (A.M. '43), age 64, civil construction engineer for the U. S. Bureau of Reclamation at Coachella, Calif., died on November 8. Mr. Kalten-

(Continued on page 98)



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Deceased

(*Continued from page 96*)

bach received his C. E. degree from the University of West Virginia. From 1924 to 1931 he was employed as engineer for the Wheeling Traction Company, and for the next ten years was in the West Virginia State Road Commission at Wheeling. He then became associate engineer in the U.S. Engineer Office, and later joined the Bureau of Reclamation at Coachella.

John Martin Kemmerer (A.M. '18), age 75, president of the Kemmerer Engineering Company, Whittier, Calif., died on November 7. Educated at the University of Illinois, Mr. Kemmerer started to work for the Illinois Central Railroad. In 1914 he left to become assistant field engineer for the Bureau of Valuation, of the Interstate Commerce Commission in Chicago. After World War I he had a private practice in Whittier, where he planned the city's outfall sewer. The Kemmerer Engineering Company was started after the past war.

John R. Kinney (M. '52), age 44, senior civil engineer for Kansas City, Mo., died on December 28. Mr. Kinney joined the Army Corps of Engineers in 1933 for work in the Rock Island, Ill., District and returned there after his graduation from Iowa State College in 1935. He was made assistant engineer aid in 1937, and later was engineer in the U. S. Engineer Office in Kansas City. He then worked for Black & Veatch as hydraulic engineer. In 1947 he became civil engineer for the Kansas City Department of Public Works, and he had been senior civil engineer since 1948.

Frank Alvah Kittredge (M. '21), age 71, retired chief engineer for the National Park Service, died at his home in Palo Alto, Calif., on December 10. Mr. Kittredge graduated from the University of Washington in 1912 and received his C. E. degree there in 1915. With the Bureau of Public Roads from 1915 to 1927, Mr. Kittredge surveyed and designed the Going-to-the-Sun Highway in Glacier National Park in 1924. The following year the National Park Service requested that he be assigned to prepare an over-all program of roads in the park system, and in 1927, he was selected by the Service to be the first chief of its engineering division. He was later made regional director of Region 4, returning to the position of chief engineer with headquarters in Washington, D.C., in 1947. Mr. Kittredge retired in 1952.

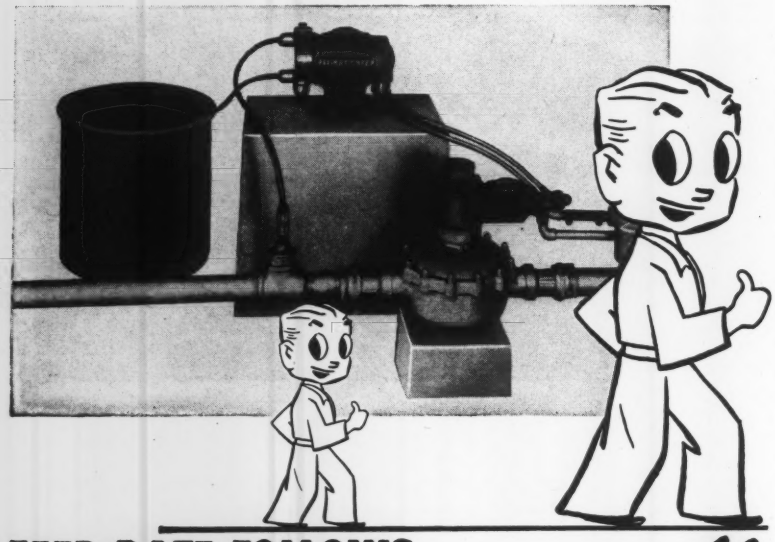
F. A. Kittredge

John Laskowski (A.M. '36) age 49, supervisor in charge of the Coast and Geodetic Survey at Fort Worth, Tex., died on November 9. In 1927 Commander Laskowski was graduated from the University of North Dakota. The following year he joined the Coast and Geodetic Survey, which he served as a hydrographic and geodetic engineer for the next 26 years. During the war he was transferred to duty with the United States Navy where he was executive officer of the ship, *Hydrographer*, doing surveys in the waters around Newfoundland, the Aleutians, and many Pacific Islands.

Valentine Brousseau Libbey (A.M. '23), age 59, vice-president and manager of the Hawaiian Bitumuls Company, Ltd., Honolulu, Hawaii, died on August 7. Mr. Libbey was a graduate of Worcester Polytechnic Institute. In 1920 he went to Hawaii to become assistant engineer for the City and County of Honolulu. After 1923 he was superintendent of Concrete & Asphalt Products, joining the Hawaiian Bitumuls Company at the close of the war.

Albert Carl Lieber (M. '37), age 59, Major General, Army Corps of Engineers, died on November 9 at Fort Leonard Wood, Mo., where he was in the Office of the Commanding General. General Lieber served in the Corps of Engineers from the time of his graduation from Massachusetts Institute of Technology in 1916

(*Continued on page 102*)



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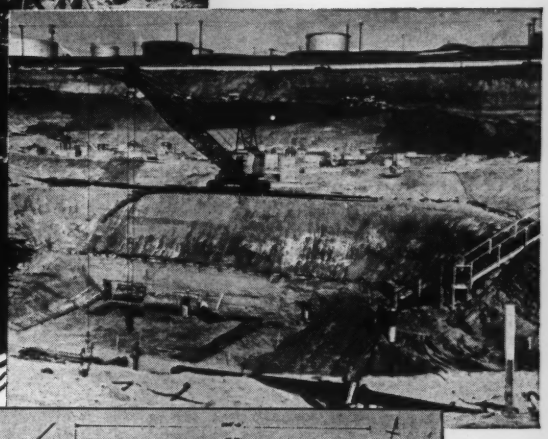

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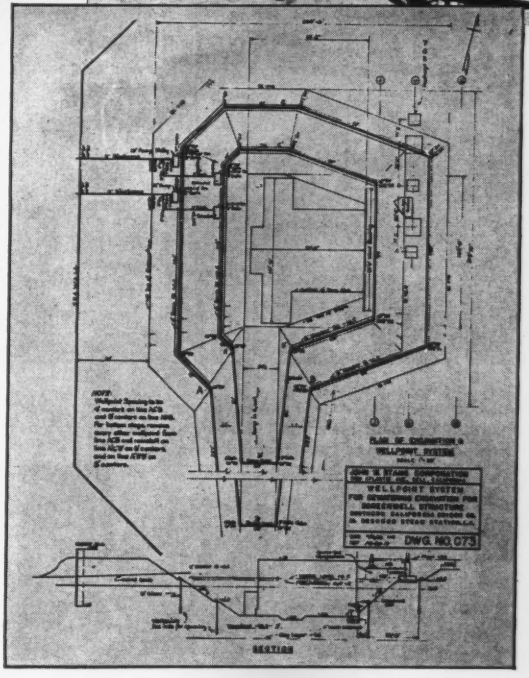
water under control!

STANG wellpoint job in beach sand...Down to 60 feet—30 feet below water level...*only 500 feet from ocean!*

Plans for an oceanside steamplant power station called for the construction of a reinforced concrete screenwell structure. Water and soil conditions were extremely adverse. The John W. Stang Corporation Engineering Service was called in. The resultant STANG plan (illustrated) *provided* completely dry excavation from the surface to a 60 foot depth . . . *utilized* dry-land excavation equipment 30 feet below water level . . . *made possible* the use of low-cost concrete forms. For fastest low-cost, construction when water is a problem . . . call STANG!



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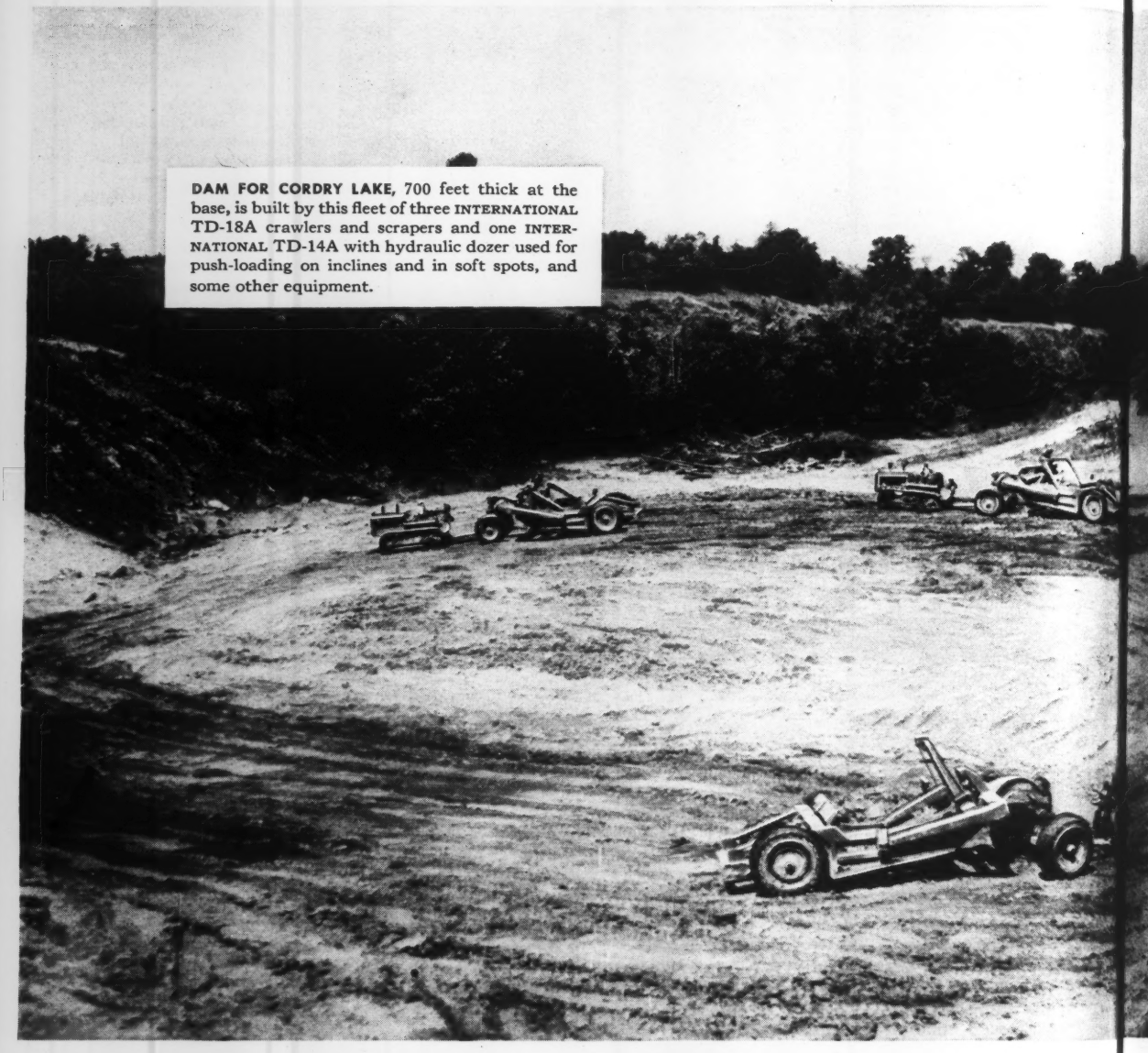
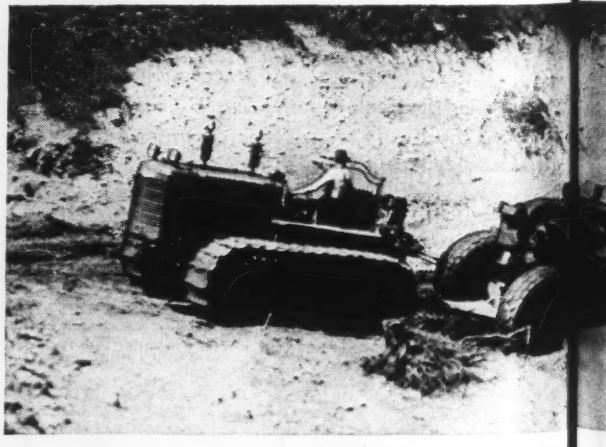


DAM FOR CORDRY LAKE, 700 feet thick at the base, is built by this fleet of three INTERNATIONAL TD-18A crawlers and scrapers and one INTERNATIONAL TD-14A with hydraulic dozer used for push-loading on inclines and in soft spots, and some other equipment.

LAKE LEAKAGE is eliminated by removing all porous soil and stone from the site of the dam base and replacing it with impervious clay fill from distances up to 1,000 feet from a nearby hill.

BUILDING UP THE DAM BASE moves along on schedule as one of three TD-18A scraper combinations brings a heaping load of clay to the construction site.



Moves 1,000,000 cubic yards to build a lake

Howard Prince, veteran Indiana contractor, has used INTERNATIONAL crawlers to build more than 100 lakes since 1935—and he has two large lakes under construction right now!

A water shortage is being remedied and a new vacation area opened by a chain of fourteen lakes being built across Brown County, Indiana, by veteran lake builder Howard Prince, head of the Prince Lake Building Company, Nineveh, Indiana.

Latest and largest in the chain is Cordry Lake, the 103rd lake to be built by Prince.

Cordry Lake, which will eventually cover more than 600 acres, is being created by building a dam 750 feet long, 120 feet high, across two small streams. In excavating unsuitable material from the dam site and borrowing leakage-proof clay from a nearby hill, the lake builders will move over 1,000,000 cubic yards of dirt.

The entire job is being handled by Prince's fleet of seven INTERNATIONAL crawlers with matched IH scrapers and blades, and some other equipment.

Howard Prince has been an INTERNATIONAL owner ever since he first started in business, and states: *"I bought my first* INTERNATIONAL *crawler in 1935 and I've been using them ever since.*

"I've been increasing my INTERNATIONAL *equipment until I now have three TD-18As with scrapers, two TD-14As with blades, a TD-9 and two TD-6s on this job.*

"On lake building projects, as well as all other types of work, they have proved both dependable and economical through the years."

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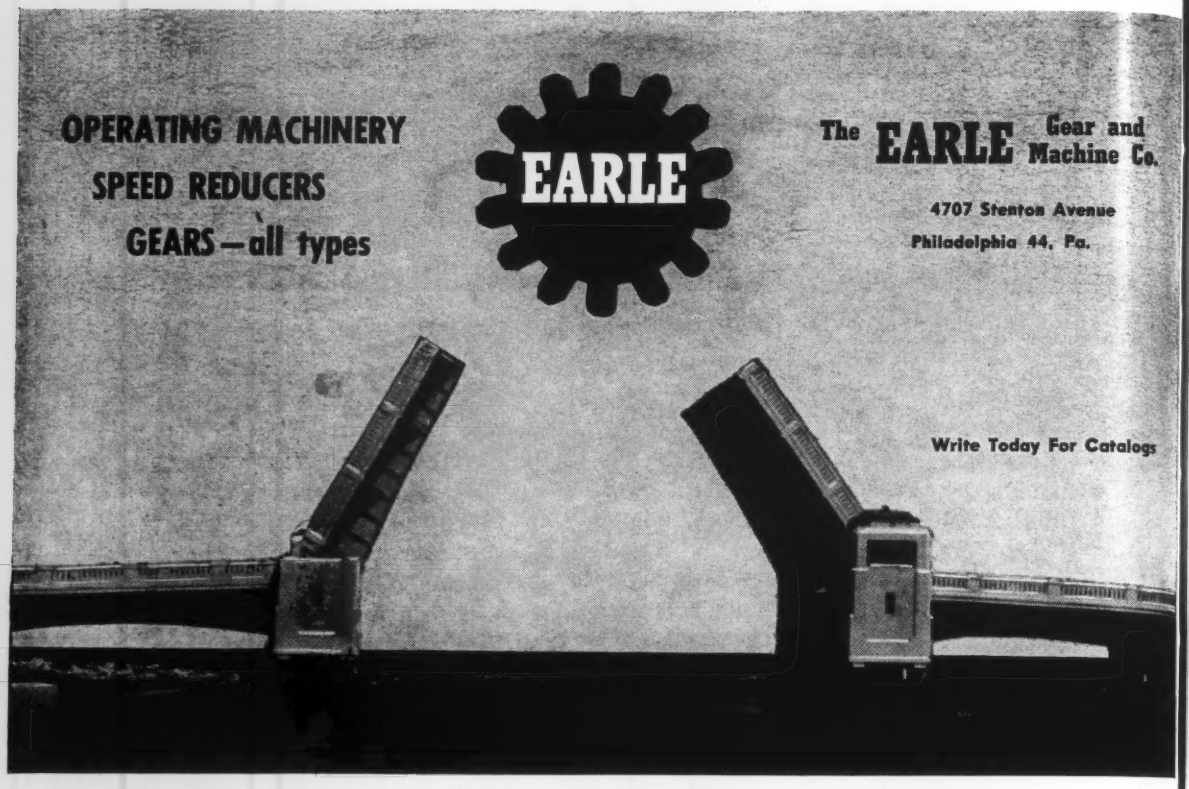
REMEDY FOR NATURE'S OVERSIGHT. The Brown County Lake Development project is adding immeasurably to the natural beauty of that Hoosier county by building 14 lakes in an area that has all the scenic wonders except lakes.



Deceased

(*Continued from page 98*)

until his death. His assignments included two years as executive officer in charge at Galveston, Tex.; five years as instructor in the Army Engineer School; three years as executive officer for the Zanesville Engineer District; and two years in charge of field studies and laboratory research in the Office of the Chief of Engineers, Washington. Before his transfer to Fort Leonard Wood General Lieber was commanding officer of the Engineer Replacement Training Center at Fort Belvoir, Va.

Alfred F. J. Miller (M. '30), age 57, chief structural engineer of the Los Angeles Department of Building and Safety, died on September 10. Mr. Miller graduated from the University of Southern California in 1920 and then started work for the Los Angeles Harbor Department. The following year he joined the Building Department, becoming chief engineer in 1924. In 1927 he was made chief structural engineer.

William Henry Owen (M. '43), age 55, president of the Owen & Welch Engineering & Contracting Co., Columbia, Mo., died on August 3. Following his graduation from Iowa State College in 1925, Mr. Owen spent four years as resident engineer for Consoer, Older & Quinlan of Chicago. From 1929 until 1934 he was designing engineer for the Missouri State Highway Department at Hannibal, and later was resident engineer inspector for PWA and assistant engineer for defense construction on the Panama Canal.

George Franklin Pawling (M. '23), age 75, structural engineer for Day & Zimmerman of Philadelphia, died on December 1. A graduate of the Pencoyd Engineering School and Temple University, Mr. Pawling first worked for the Pencoyd Iron Works and then the New York Shipbuilding Co. In 1903 he joined the Philadelphia Rapid Transit Co. and later became a partner in the firm of Bergdoll & Pawling. In 1911, Mr. Pawling started his own design and contracting company.

Boris Michael Shimkin (A.M. '28), age 66, associate bridge design engineer for the California State Highway Division in San Francisco, died in December. A 1914 graduate of the Tomsk Technological Institute in Russia, Mr. Shimkin worked for a number of railroad companies and later studied at the University of California receiving his degree in 1928. He started work for the California State Highway Department in 1933.

Harry Augustus Shuptrine (M. '35), age 67, since 1919 bridge engineer of the Wayne County (Michigan) Road Commission, Detroit, died on December 6. Following his graduation from the University of Michigan in 1909, Mr. Shuptrine was employed by the Mt. Vernon Bridge Company, the Chesapeake and Ohio, and the Dominion Bridge Company. In his position with the Wayne County Road Commission, which he joined in 1919, Mr. Shuptrine was in charge of all bridge and grade separation work and of all construction on the John C. Lodge Expressway. He was a past-president of the Michigan Section of ASCE, and of the Michigan Engineering Society.

Fred Washburn Simonds (M. '28), age 72, retired engineer of Concord, Mass., died on December 7. Well known as a sanitary engineer, Mr. Simonds was with the Boston engineering firm of Metcalf & Eddy until his retirement recently on account of ill health. In his early career he was village engineer for Ridgewood, N.J., where he also had a private engineering practice. Later he was associated with the Nicholas S. Hill, Jr., Company (now the Buck-Seifert and Jost Company) in New York City, and with William M. Piatt at Durham, N.C. During the war he was with the Caribbean Architect-Engineers in the West Indies designing water and sewer facilities for the U.S. Army bases. He was a graduate of MIT, class of 1905.

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Mr. R. E. Cannard
Manager, City of Manitowoc
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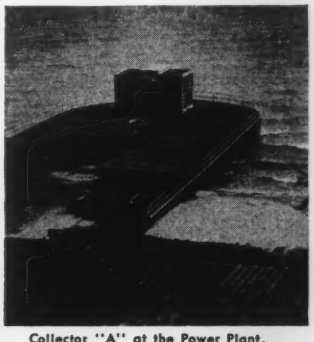
the RANNEY METHOD a "MUST" for the CITY OF MANITOWOC, WISCONSIN

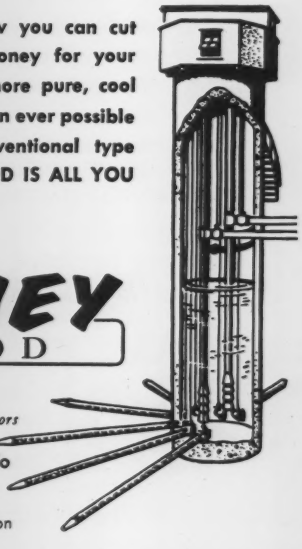


Collector "A" at the Power Plant, City of Manitowoc

Mr. Cannard says, "We have found the RANNEY to be far more efficient than the conventional type wells. Our RANNEY collectors require less personnel, fewer pumps, cuts operating costs, and eliminates filter stations altogether. The RANNEY METHOD has solved our water problems and the collectors are just as good today as they were when they were installed ten years ago."

FOR YOUR CITY TOO

Write now, and learn how you can cut unnecessary costs, save money for your community, and produce more pure, cool water from just one well than ever possible before, with multiple conventional type wells. THE RANNEY METHOD IS ALL YOU NEED.



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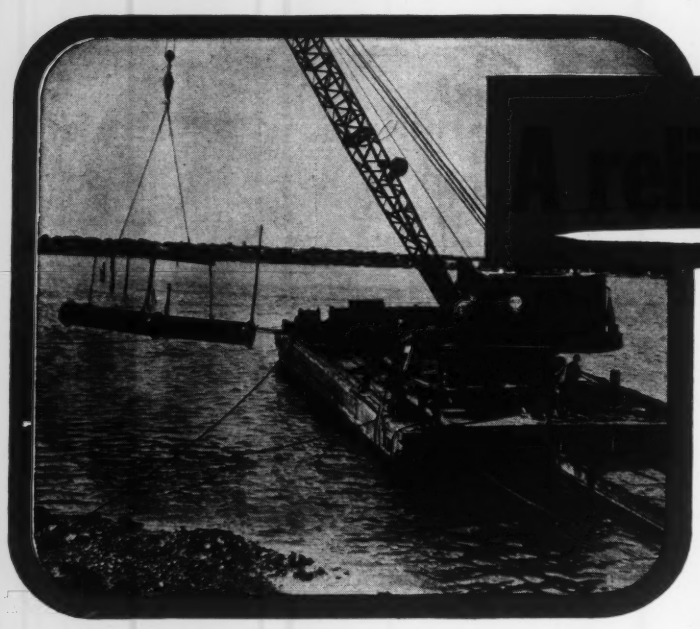

Installing 30-inch cast iron mechanical joint pipe for outfall sewer at East Providence, R. I

A reliable material

Where installations are planned for long-term service to assure low cost per service year, engineers rely on cast iron pipe as a dependable and adaptable material. Consequently, it is specified for a wide variety of applications, both utility and industrial, including water supply, gas, sewerage, fire protection, power plants, oil refineries, process industries and many forms of special construction. Long life and low maintenance cost are *proved* results of the high beam-strength, compressive-strength, shock-strength and effective resistance to corrosion of cast iron pipe. For information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.

(above)
Laying 16-inch cast iron pipe alongside railroad tracks at Ft. Lauderdale, Florida.

(at right)
Cast iron pipe being installed for large process industry plant in Chicago.

Cast Iron Pipe

for permanent construction

(above)
Installing 30-inch cast iron pipe for sewage treatment plant at Panama City, Florida.

(at left)
Eight-inch mechanical joint cast iron pipe installed under difficult conditions to carry coal mine water at Sumiton, Ala.

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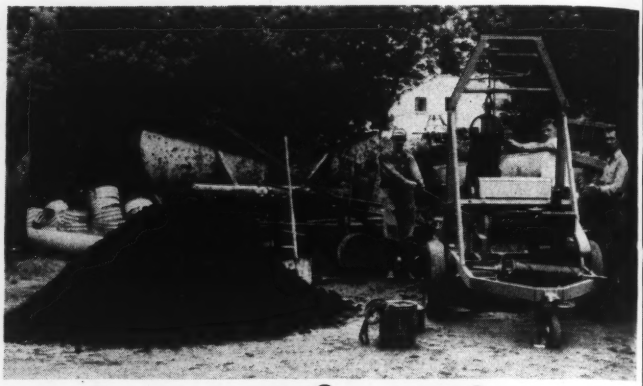
CUTTING SEWER MAINTENANCE COSTS WITH "Flexibles" AT LAPEER, MICHIGAN

Over 4 yards of sand just removed from the first 125 feet of trunk line in record time. No working at bottom of manhole; all deposits dumped at the street level. Just the start of an easy job that would have been tough *without* "Flexibles."

Sand, gravel, mud, rocks, roots, grease or slime–whatever your city's problems–"Flexibles" take them in stride, in all weather. For emergency cleaning or preventative maintenance, "Flexibles" are easier on the men–easier on the taxpayer. And there's a "Flexible" model for every requirement...budget or otherwise.



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Non-ASCE Meetings

American Concrete Institute. Fifty-first Annual Convention at the Hotel Schroeder, Milwaukee, Wis., Feb. 21–24.

American Concrete Pipe Association. Forty-seventh Annual Convention and Meeting at the Sheraton-Plaza Hotel, Boston, Mass., Mar. 9–12.

American Congress on Surveying & Mapping. Fifteenth Annual Meeting at the Shoreham Hotel, Washington, D.C., Mar. 7–8.

American Institute of Electrical Engineers. Utilization of Aluminum Conference at the William Penn Hotel, Pittsburgh, Pa., Mar. 15–17. Materials Handling Conference, at the Hotel Cleveland, Cleveland, Ohio, Mar. 28–29.

American Institute of Mining and Metallurgical Engineers. Annual Meeting at the Conrad Hilton Hotel, Chicago, Ill., Feb. 12–17.

American Society for Metals. Ninth Western Metal Congress and Exposition, sponsored by the American Society for Metals and other groups, at the Ambassador Hotel and the Pan-Pacific Auditorium, Los Angeles, Calif., Mar. 28–April 1.

American Society of Mechanical Engineers. National Meeting (Founding Anniversary Meeting) in New York City, Feb. 16. First International Congress on Air Pollution at the Hotel Statler, New York, Mar. 1–2.

American Society of Photogrammetry. Twenty-first Annual Meeting at the Hotel Shoreham, Washington, D.C., Mar. 7–9.

Annual Highway Engineering Conference. Annual Conference sponsored by the University of Colorado at Boulder, Colo., Feb. 24–25.

Associated General Contractors of America. Thirty-sixth Annual Convention in New Orleans, La., Mar. 14–17. Information from A.G.C. Headquarters, Munsey Building, Washington 4, D.C.

College-Industry Conference. Sponsored by the Relations with Industry Division of the American Society for Engineering Education and the Iowa Engineering Society at Des Moines, Iowa, Mar. 1–2.

Concrete Contractor's Association of Greater Chicago. Mid-West Concrete Conference & Exposition at the Navy Pier, Chicago, Feb. 24–25.

High-Speed Computer Conference. Sponsored by the Louisiana State University, at Baton Rouge, Feb. 14–16.

Illinois Highway Engineering Conference. Forty-first Annual Conference at the University of Illinois, Urbana, Ill., Mar. 1–3.

National Air Pollution Symposium. Third Symposium at the Huntington-Sheraton Hotel, Pasadena, Calif., April 18–20. Sponsors are Stanford Research Institute, the California Institute of Technology and others.

National Association of Corrosion Engineers. Eleventh Annual Conference and Exhibition at the Palmer House, Chicago, Mar. 7–11.

National Society of Professional Engineers. Spring Meeting at the Hotel Charlotte, Charlotte, N.C., Feb. 18–19.

Society of American Military Engineers. Military-Industrial Conference at the Conrad Hilton Hotel, Chicago, Feb. 10–11.

Southern Municipal and Industrial Waste Conference. Fourth Annual Conference co-sponsored by Duke University, the University of North Carolina and North Carolina State College at Duke University, Durham, N.C., Mar. 31–April 1.

Steel Founders' Society of America. Annual Meeting at the Drake Hotel, Chicago, Ill., Mar. 14–15.

New in Education

Illinois Institute of Technology. The Institute must obtain at least $13,000,000 in gifts to complete the Technology Center campus it is developing on Chicago's southside, according to President John T. Rettaliata. He says that the Institute should erect at least nine additional college buildings, providing some 615,000 sq ft of classroom and laboratory floor space, within the next ten to fifteen years. "The basic need is to have adequate facilities to educate more young men and women to become scientists and engineers that our nation's heritage may survive in the future," Dr. Rettaliata points out. In recent years more than 5,000 engineering students have enrolled in the college's day and evening classes.

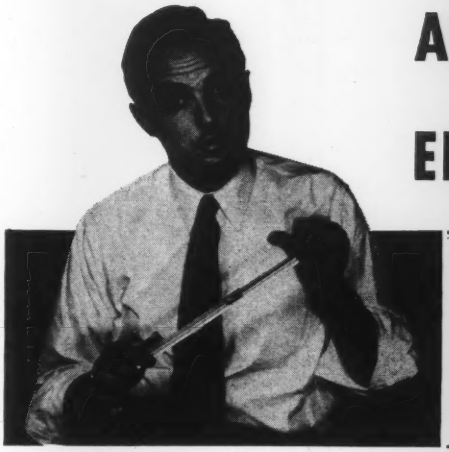
D. B. Steinman Foundation established. D. B. Steinman, well-known bridge engineer, has established the David B. Steinman Foundation, Inc., for the purpose of making contributions and grants to educational institutions and other worthy causes. The principal objective is to make gifts to engineering schools for establishing scholarships, awards, and loans to aid deserving students to complete their engineering studies or to pursue full-time graduate work in engineering. The loans or grants will range from $100 to $500.

A summer program is open to highway engineering instructors. The University of California's Institute of Transportation and Traffic Engineering will conduct an eight-week advanced-study program in highway engineering for college instructors of engineering. In order that instructors from different parts of the country may enroll, the Automotive Safety Foundation has established twenty grants-in-aid of $650 each. The curriculum will consist of two three-unit graduate courses carrying graduate credit—Highway Planning and Economics and Advanced Traffic Engineering—and seven seminar sessions with specialists in highway transportation participating. Tuition will be $75 and G.I. benefits may be used. Applications for grants-in-aid should be submitted by March 14, and forms and information are available from the Institute of Transportation and Traffic Engineering, University of California, Berkeley 4, Calif.

Bethlehem Steel has an effective college-aid program. Payments totaling $321,000 have been made to thirty educational institutions by Bethlehem Steel under the company's Program of Financial Assistance to Colleges and Universities, according to E. G. Grace, chairman of the company. This is in addition to other amounts paid to colleges for research specifically requested by the company or of direct benefit to the steel industry as a whole. Payments to privately endowed colleges under the Bethlehem program, which was initiated in 1953, can be applied to scholarships, facilities, or any other purpose that in the judgment of the college will best meet its needs.

WHO...ME?

AN *AIRCRAFT* ENGINEER?



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Yes, Lockheed in California can train you...at full pay!

The step up to Aircraft Engineering isn't as steep as you might expect. Aircraft experience isn't necessary. Lockheed takes your knowledge of engineering principles, your experience in other engineering fields, your aptitude and trains you for aircraft work through a program adapted to the individual.

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Naturally, you receive full pay while training, as well as a wide range of extra employee benefits which add approximately 14% to your salary in the form of insurance, retirement pension, etc.

These opportunities for engineers in all fields have been created by Lockheed's long-range development program. Projects include: turbo-jet and turbo-prop transports; supersonic fighters far exceeding present-day aircraft in performance; advanced versions of vertical rising aircraft, jet trainers and bombers; nuclear energy applications to aircraft; and a large number of significant classified projects.

From a career standpoint, it is significant that a large measure of Lockheed's development program involves commercial aircraft.

Equally important from a living standpoint is the better life you lead in Southern California. Year-round sunshine, varied cultural and recreational opportunities, and scenic beauty of San Fernando valley provide the ideal background for modern living.

You are invited to write for a brochure describing life and work at Lockheed and a job application blank. Coupon below is for your convenience.

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Dear Sir: Please send me your brochure describing life and work at Lockheed in Southern California

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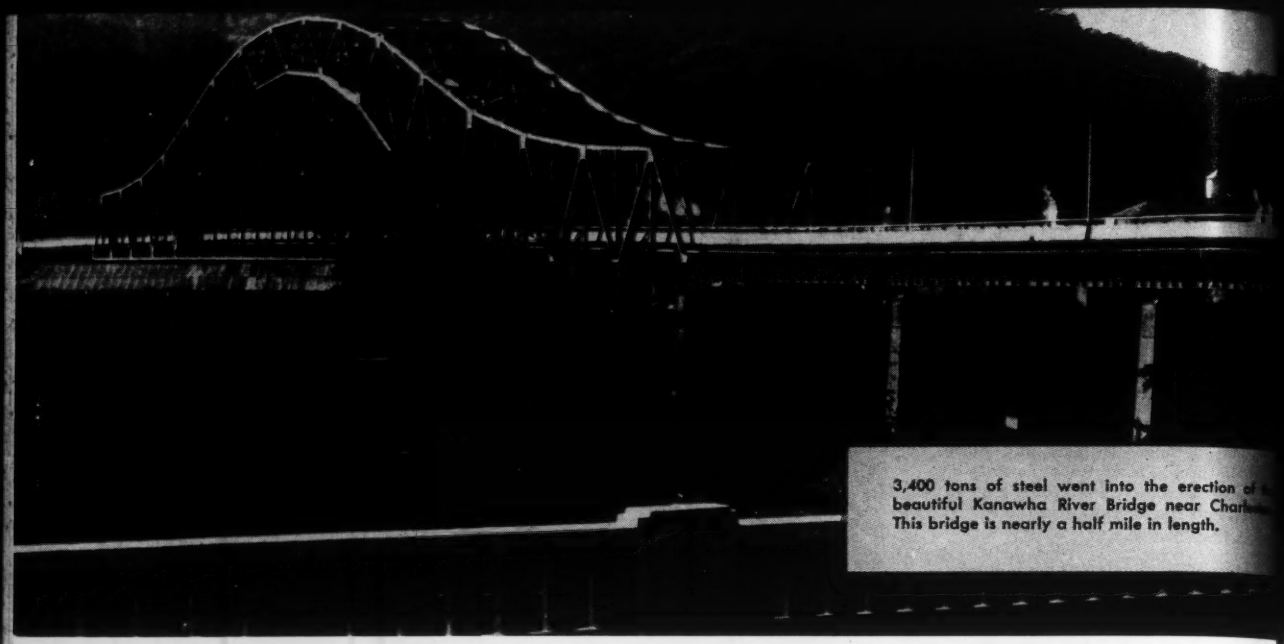
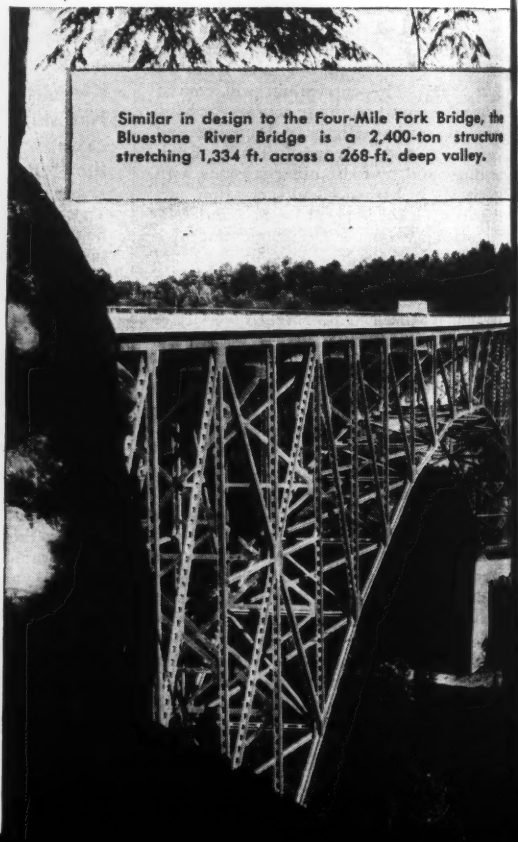


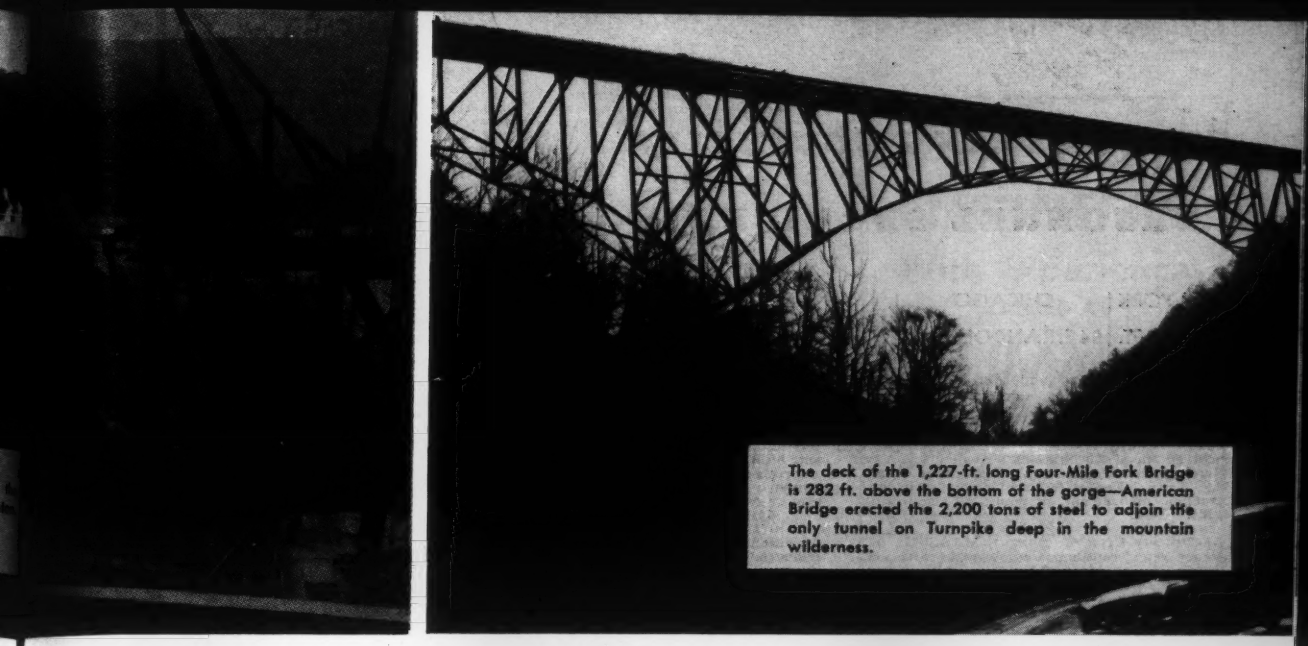
3,400 tons of steel went into the erection of t beautiful Kanawha River Bridge near Charle This bridge is nearly a half mile in length.

ALL 76 BRIDGES ON WEST VIRGINI

World's largest builder of bridges sets record in erecting 19,000 tons of steelwork on rugged mountain expressway



Similar in design to the Four-Mile Fork Bridge, the Bluestone River Bridge is a 2,400-ton structure stretching 1,334 ft. across a 268-ft. deep valley.



The deck of the 1,227-ft. long Four-Mile Fork Bridge is 282 ft. above the bottom of the gorge—American Bridge erected the 2,200 tons of steel to adjoin the only tunnel on Turnpike deep in the mountain wilderness.

TURNPIKE ERECTED IN 11½ MONTHS by AMERICAN BRIDGE

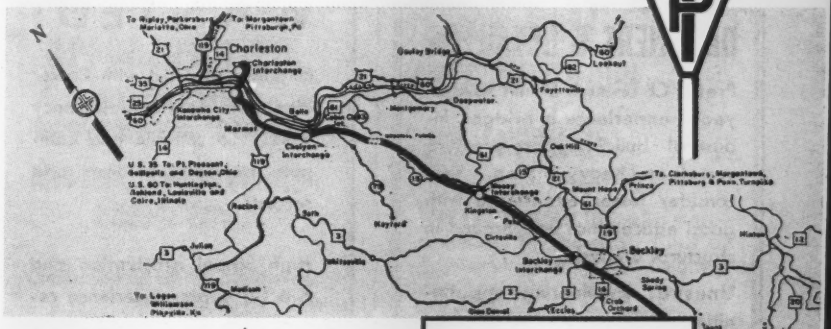
Constructed over, around and under some of the most treacherous mountain terrain east of the Rockies, the new West Virginia Turnpike is one of the nation's best stretches of highway. And one of the most bridged. For it has 76 bridges along its 87-mile length. That's almost a bridge a mile!

But equally interesting is the fact *one single company* erected the structural steelwork for *all 76 bridges.* And did it in just 11 months and 17 days!

AMERICAN BRIDGE put 19,000 tons of structural steel into these bridges, three of which are major structures as you can see from the photographs shown here. The 73 minor bridges averaged 230 ft. in length. In addition to erecting all 76 bridges, AMERICAN BRIDGE fabricated approximately 14,000 tons of steelwork, including the three major bridges.

The engineering "know-how" and the skilled manpower that AMERICAN BRIDGE brought to this vast bridge-building project *enabled this one single company to handle this big job in its entirety in record time.* This same kind of service is available *anytime, anywhere* to help you save time and money on any project involving the fabrication and erection of structural steelwork.

AMERICAN BRIDGE welcomes an opportunity to estimate on your next job. For a detailed discussion of your plans, just contact the office nearest you.



OWNERS:
West Virginia Turnpike Commission

General Consultants and Designers of Bridges:
Howard, Needles, Tammen & Bergendoff

Erection of Steelwork for all Bridges:
American Bridge Division, United States Steel Corp.

See "THE UNITED STATES STEEL HOUR"—Televised alternate weeks—Consult your newspaper for time and station.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

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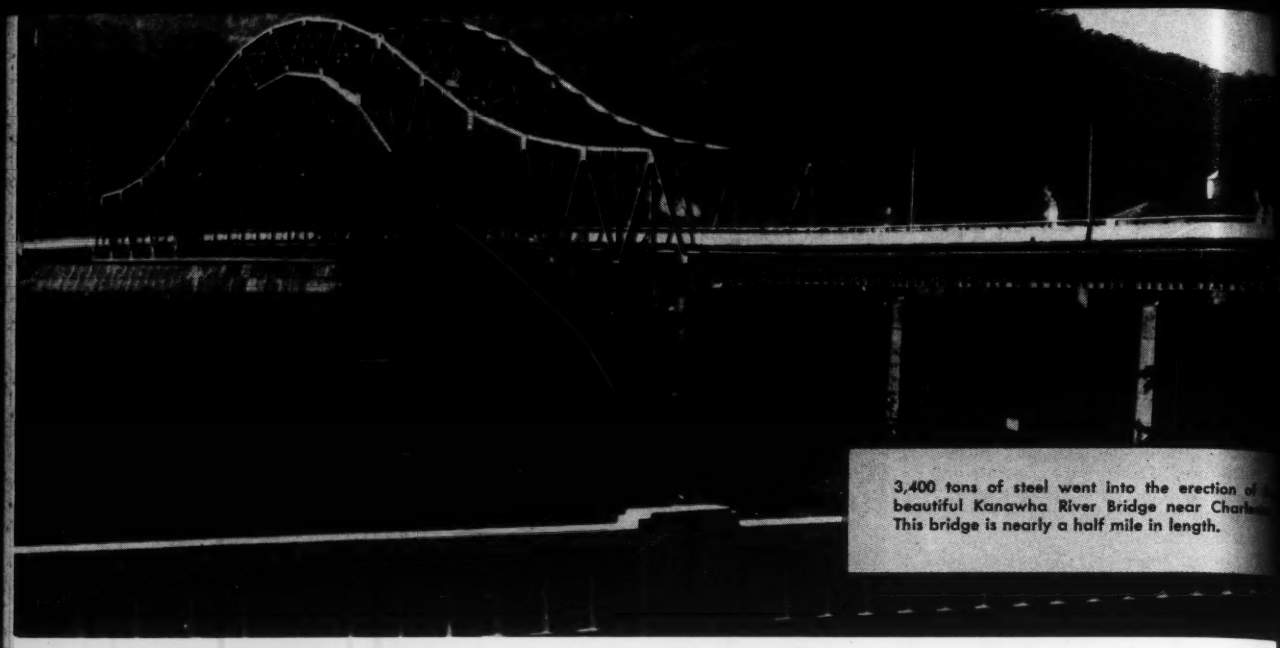
AMERICAN BRIDGE

USS

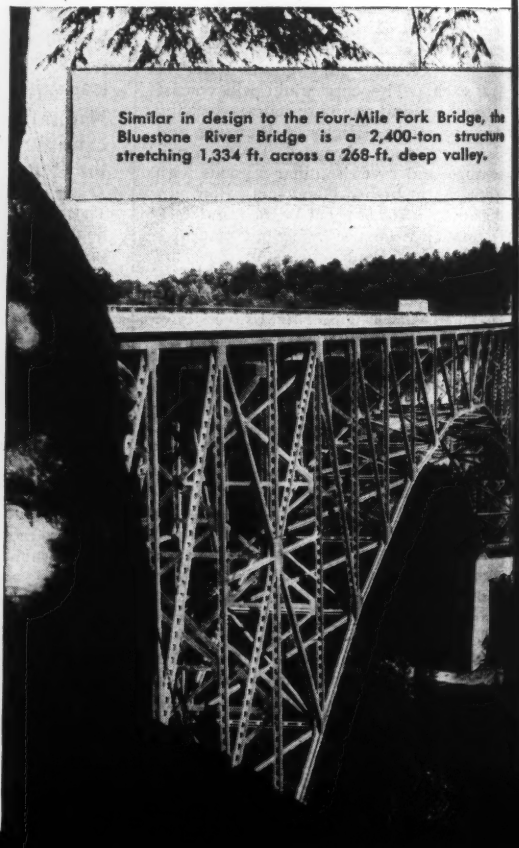
UNITED STATES STEEL



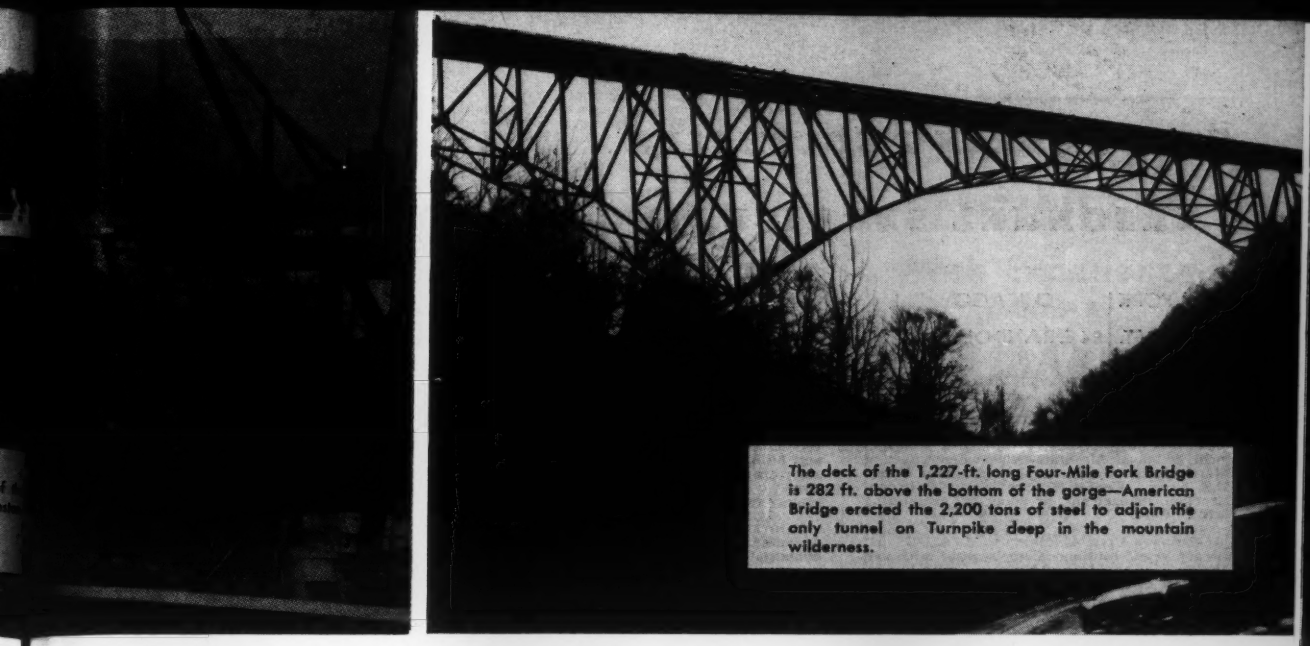
3,400 tons of steel went into the erection of beautiful Kanawha River Bridge near Charl... This bridge is nearly a half mile in length.

ALL 76 BRIDGES ON WEST VIRGIN

World's largest builder of bridges sets record in erecting 19,000 tons of steelwork on rugged mountain expressway



Similar in design to the Four-Mile Fork Bridge, the Bluestone River Bridge is a 2,400-ton structure stretching 1,334 ft. across a 268-ft. deep valley.



The deck of the 1,227-ft. long Four-Mile Fork Bridge is 282 ft. above the bottom of the gorge—American Bridge erected the 2,200 tons of steel to adjoin the only tunnel on Turnpike deep in the mountain wilderness.

TURNPIKE ERECTED IN 11½ MONTHS

by AMERICAN BRIDGE

Constructed over, around and under some of the most treacherous mountain terrain east of the Rockies, the new West Virginia Turnpike is one of the nation's best stretches of highway. And one of the most bridged. For it has 76 bridges along its 87-mile length. That's almost a bridge a mile!

But equally interesting is the fact *one single company* erected the structural steelwork for *all 76 bridges.* And did it in just 11 months and 17 days!

AMERICAN BRIDGE put 19,000 tons of structural steel into these bridges, three of which are major structures as you can see from the photographs shown here. The 73 minor bridges averaged 230 ft. in length. In addition to erecting all 76 bridges, AMERICAN BRIDGE fabricated approximately 14,000 tons of steelwork, including the three major bridges.

The engineering "know-how" and the skilled manpower that AMERICAN BRIDGE brought to this vast bridge-building project *enabled this one single company to handle this big job in its entirety in record time.* This same kind of service is available *anytime, anywhere* to help you save time and money on any project involving the fabrication and erection of structural steelwork.

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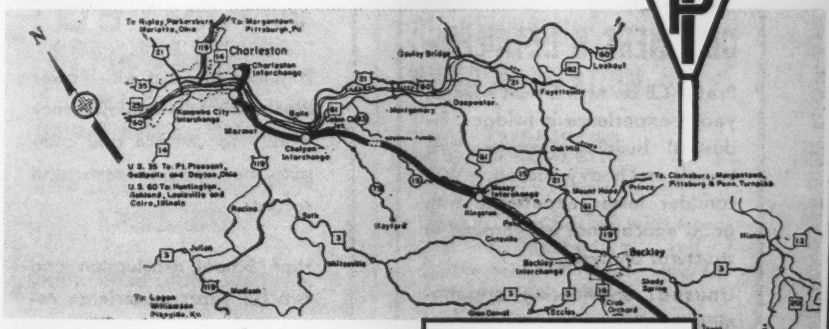

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER; J.M. ASCE; 24; married; B.C.E., 1951; three years' responsible experience in Public Works Administration, Planning, Maintenance, Construction, and Contract Management at Naval Air Stations. Available late in March upon release from Civil Engineer Corps, U.S. Navy. Desires responsible position in construction, managment, or municipal engineering fields. C-18.

GRADUATE CIVIL ENGINEER; M. ASCE; 51; twenty years' continuous employment with and became vice-president of heavy engineering construction company. Qualified in all phases of field and office work, including estimating, contract negotiation and job management; Licensed Professional Engineer. C-19-57; Chicago.

RESEARCH PROFESSOR; A.M. ASCE; 38; married; Ph.D.; 14 years' experience in design, construction, research and teaching mainly in soil engineering and highway engineering. Interested in doing research work or teaching soils, highways, and airports. Desires position as research engineer, assistant professor or associate professor. C-20-39; Chicago.

CONSTRUCTION EXECUTIVE; Graduate Engineer desires administrative, executive or sales position in construction field, or where an executive engineer is needed. Has 30 years' experience self-employed in building construction, including work of every description such as, schools, hospitals, public housing, military work, commercial and private work. Southern United States, Far West or foreign locations. C-21.

CIVIL ENGINEER; J.M. ASCE; married; B.S.C.E., 1950; four years as a mechanical engineer on AEC construction; one year in plant engineering for a manufacturer; three years in U.S. Army as a surveyor and photomapper; will accept overseas employment. C-22.

SANITARY ENGINEER; A.M. ASCE; licensed; advanced degree. Ten years of comprehensive industrial experience in responsible charge of administration, design, construction, research, developmental and operational phases of waste disposal, pollution control, water supply and water treatment. C-23.

STRUCTURAL ENGINEER; J. M. ASCE; 34; married; registered Texas; B.S. and M.S. in Architectural Engineering at University of Colorado and University of Texas. Extensive experience in structural design of industrial and commercial buildings, churches, hospitals, and schools. Three years' service in the Civil Engineers Corps U. S. Navy. Prefers West or Midwest. C-24.

CONSTRUCTION ENGINEER OR SUPERINTENDENT; A.M. ASCE; 48; married; 20 years' experience in highway, street, airport, sewer, water line and miscellaneous heavy construction at the supervisory and administrative level; six years' experience in pre-mix concrete business at the executive level. Has had special courses in business administration and concrete design. C-25-10; Detroit.

Positions Available

RESIDENT ENGINEER; experienced in bridge and highway construction. Salary, $6,600-$7,000 a year. Duration two years. Location, East. W-937.

FIELD ENGINEER AND ESTIMATOR; civil graduate, with concrete building construction experience. Salary, $5,200-$5,720 a year. Location, Long Island, New York. W-933.

SALES REPRESENTATIVE; 28-35; civil or mechanical graduates, with metal sales experience in building materials field to call on architects, engineers and contractors covering design, installation, specifications, costs, etc., for aluminum products. Some traveling on out-of-town projects. Salary, $6,000-$8,000 a year. Location, New York, N.Y. W-927.

INSTRUCTOR; to teach plane surveying, strength of materials and hydraulics or elementary mechanics and surveying. Practical experience is not essential. Position starts Sept., 1955. Location, Southwest. Salary open. W-883.

CITY PLANNERS; to direct work of a technical staff. At least eight years' planning experience and a degree in City Planning. Civil Engineering or Landscape Architecture essential. Salary: $8,000-$10,000. Location, South. C-2474.

STRUCTURAL
DESIGNERS & DETAILERS

Prefer CE or Arch E with several years' experience in bridges, industrial buildings, or pressure vessels and heavy ducting. Will consider lesser experience with good educational background in structural analysis.

Unusual engineering opportunities exist in our well established firm in connection with the design of a wide variety of engineering projects in both concrete and steel. Included are bridges, industrial buildings, advanced test facilities and other construction of an industrial nature, and various types of highway work.

Please write fully to—

SVERDRUP & PARCEL, INC.
Consulting Engineers
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Engineer to assist with Power Plant instrument and efficiency work. To compile and compute performance tests and records.

High School graduation and two (2) years experience required; college training desirable. Good opportunity to further college education. Civil Service benefits and security $3600–$4800 per year.

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University of Illinois
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Outstanding opportunities with America's oldest and fastest moving aircraft company. We are the designers and builders of the Navy Seamaster, B-61 Matador and Viking Rocket. Openings in —

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AIRCRAFT EXPERIENCE NOT NECESSARY

We are also interested in recent engineering graduates having B.S., M.S. and Ph.D. degrees.

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Professional Employment
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JUNIOR CIVIL ENGINEERS

College degree in Civil Engineering required. Salary $395 to start, with merit increases to $464 per month. Positions offering generalized experience available in both Highway and Flood Control work.

Apply—

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Civil and Structural Engineers

To design new oil-refineries and chemical plants. The work is basically a design of steel and reinforced concrete structures. And site-development engineering.

Please send your resume to our Personnel Department. Your letter will receive immediate and confidential attention.

C F BRAUN & CO
ENGINEERS CONSTRUCTORS
ALHAMBRA
CALIFORNIA

ENGINEERS; (*a*) Design Engineer; civil graduate, with at least ten years' arch dam and heavy construction experience. (*b*) Design Engineer; civil or mechanical graduate, with at least ten years' experience covering field survey, design and layout of grain storage silos and materials handling equipment. (*c*) Design Engineer; civil graduate with at least ten years' experience on highway and bridge design. Salary plus allowances. Location, Middle East. F-875.

DESIGN ENGINEER; with at least five years' experience on highways, for consulting firm. Location, New York, N.Y. Salary open. W-874.

STRUCTURAL DESIGNER; with at least ten years' steel and concrete experience for consulting engineering firm. Salary, $7,280 a year. Location, New York, N.Y. W-871.

INSTRUCTOR; in civil engineering, M.S. degree and some experience in teaching required. The appointment would be for three years, round-trip travel would be furnished and maintenance would be provided. Position available in the fall of 1955. Location, Near East. Salary open. F-856.

INSTRUCTOR; civil engineering, preferably with M.S. degree; practical or teaching experience; major interest sanitary engineering desired but not required. Position open in the fall of 1955. Location, Midwest. W-923.

OFFICE ENGINEER; young; architectural or civil graduate, with commercial building engineering and alteration experience to supervise field operations for chain organization. Limited traveling. Salary, $6,000 a year, plus bonus. Location, New York, N.Y. W-921.

PROJECT MANAGER; to supervise a two million dollar site development, involving sewer, water, drainage and paving for 1000 unit subdivision. Location, Louisiana. Salary open. W-913.

JUNIOR ENGINEERS; civil graduates; under 26; with above average academic records. Veterans with no practical experience will be considered. Applicants must be willing to relocate. Salary, open. Location, Pennsylvania. W-910.

FIELD AND OFFICE ENGINEER; with at least five years' municipal engineering experience for consulting firm. Salary, $5,200–$6,500 a year. Location, N.J. Metropolitan area. W-886.

(*Continued on page 112*)

ENGINEERING OPPORTUNITIES

IN LONG RANGE GUIDED MISSILE PROGRAM

MISSILE STRUCTURES ENGINEERS

Challenging problems in:—

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Vibration

Loads

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Openings at both junior and senior levels. For additional information forward resume to:

Missile & Control Equipment Dept. C
Engineering Personnel
NORTH AMERICAN AVIATION INC.
12214 Lakewood Blvd.
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Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

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Engineering Corp.
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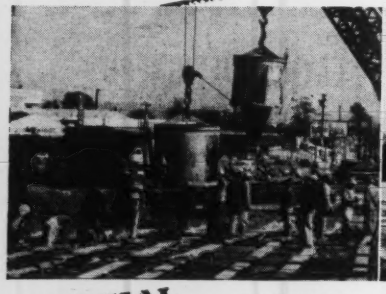
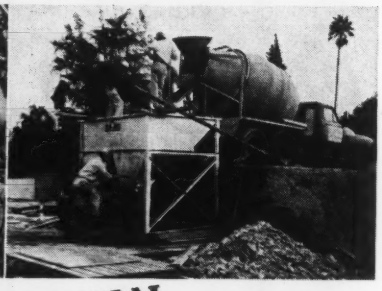
it takes SPECIAL DELIVERY on concrete jobs



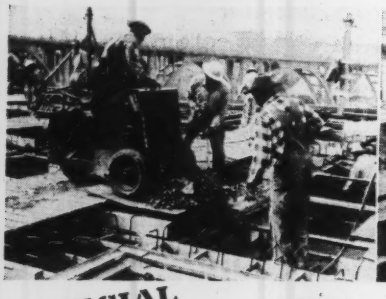


SPECIAL DELIVERY ELIMINATES RAMPS

In building construction, Gar-Bro Concrete Buckets save the cost of building ramps and scaffolds.

SPECIAL DELIVERY PREVENTS DELAYS

Delay of truck mixers, and placing and finishing crew are eliminated with Gar-Bro Hoppers.



SPECIAL DELIVERY 5 TIMES FASTER

Fast shuttle speeds over longer distances prove economy & high hourly capacity of Gar-Bro Power-Carts.

SPECIAL DELIVERY IS A 1-2-3 OPERATION

This Gar-Bro Hopper is serving as intermediate concrete storage between bucket and carts.

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EVERY CONCRETE JOB requires *special delivery* methods for handling and placing concrete *profitably*. It takes planning and it takes careful selection of equipment of the right capacity. That's the big reason why you should depend upon Gar-Bro. For only Gar-Bro has a complete line of concrete handling equipment in all sizes and capacities.

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GAR-BRO

the world's most complete line of

CONCRETE HANDLING EQUIPMENT

Men and Jobs Available

(*Continued from page 111*)

INSTRUCTOR OR ASSISTANT PROFESSOR; M.S. in civil engineering, to teach surveying, soil mechanics, fluid mechanics and normal civil engineering laboratories. Should be active in technical and professional organizations. Salary and academic rank open. Positions start September 1955. Degree and experience to determine academic rank and salary. Location, Midwest. W-868a.

STRUCTURAL ENGINEER; 30–35; with experience covering design, planning and erection of steel structures and foundations for single story commercial buildings. Salary, $6,000–$8,000 a year. Location, Louisville, Kentucky. W-863.

DISTRICT ENGINEER; 30–40; with civil engineering training and field experience covering asphalt highway design and construction. Salary, $6,000–$7,000 a year. Location, New York, Metropolitan area. W-860.

CIVIL ENGINEER; experienced in design of sewerage system and sewerage treatment plants. Salary, $6,240 or better depending on applicant. Location, Connecticut. W-859.

HIGHWAY DEVELOPMENT ENGINEERS; to conduct laboratory and field investigations on highway materials and pavements. (*a*) Engineer; under 40; with at least 5 years research and development experience in concrete and soils including planning of investigation and report writing. (*b*) Recent Graduate; with distinct interest in research and development, having training in soils or one or two years' experience on highway work. Salaries open. Location, Chicago. C-2466.

Application for Admission to ASCE, December 18, 1954–January 8, 1955

Applying for Member

LEWIS LI-TANG AU, New York, N.Y.
WILLIAM CRAWFORD DENNISTON BRIDGES, New York, N.Y.
ROY CLARK, Atlanta, Ga.
LUCIEN EDGAR HARRISON, Huntington, W.Va.
GEORGE CONRAD HESTER, JR., Salem, Ore.
HIDESHI IWAMOTO, Honolulu, T.H.
HENRY WHITE JANES, Baltimore, Md.
SHOSITIRO NAGAI, Osaka, Japan.
FRED WILSON PEARSON, Omaha, Nebr.
CARL WASHBURN PORTER, San Diego, Calif.
ROY RUGGLES, Atlanta, Ga.
HAROLD RICHMOND SHIPMAN, Maadi, Egypt.
RENE SILVA, New York, N.Y.
SIGVALD WILDHELM STEFFENSEN, New York, N.Y.
MEREDITH HARRY THOMPSON, Albany, N.Y.
CARL ANTHONY THYREGOD, Tucson, Ariz.
HARRY MCDOWALL WILLIAMSON, San Francisco, Calif.
NORMAN S. WULF, Chicago, Ill.

Applying for Associate Member

EARL HARRY BRENGLE, Chicago, Ill.
FRANCIS WILLIAM FEWORE, Dedham, Mass.
ROBERT WILLIAM GERMEROTH, New York, N.Y.
THOMAS GOLDFRANK, White Plains, N.Y.
THOMAS HENRY HABLETT, Philadelphia, Pa.
CARL DANIEL HARTZELL, Walnut Creek, Calif.
ROGER JAMES, Seattle, Wash.
BERT JAMEYSON, Oakland, Calif.
OWEN FRANKLIN JENSEN, JR., Houston, Tex.
CLARENCE HENRY KILLORAN, Niagara Falls, Ont.
OSCAR LEONARD MULFORD, New York, N.Y.
ARTHUR HENRY PLAUTZ, Indianapolis, Ind.
CLIFFORD PERCIVAL PRICE, Otago, New Zealand.
JOHN MARTIN PROOS, JR., Indianapolis, Ind.
ERWIN ALBERT SCHAFFER, Milwaukee, Wis.
LOUIS SILBERT, Brooklyn, N.Y.
FRED CULEN SOFKA, Jamaica, N.Y.
CHARLES LINDLEY THOMPSON, Indianapolis, Ind.

Applying for Junior Member

JOSE MARIA DE CASTRO, Ithaca, N.Y.
THEODORE LEE FARMER, Topeka, Kan.
MASARU KAWAGUCHI, San Francisco, Calif.
JOHN WILLIAM KRUSE, JR., Los Angeles, Calif.
CLIFTON ELMER ROY LAWSON, Ithaca, N.Y.
ROBERT FRANCIS PERKIND, Newark, N.J.
ALVARO ROCHA BORRERO, Denver, Colo.
HERNANDO RUAN, Ithaca, N.Y.
WADI SALIBA RUMMAN, Ann Arbor, Mich.
ROBERT HERMAN SCHLEIDER, JR., College Station, Tex.
ABRAM SIMOFF, East Orange, N.J.
FRED JARED WILKIE, Elmira Hts., N.Y.

[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

THE DOTS MARK A FEW OF THE STRUCTURES ON RAYMOND FOUNDATIONS. *Photo by Fairchild Aerial Surveys*

IN WASHINGTON, D. C.

276 STRUCTURES *REST ON* RAYMOND FOUNDATIONS

You may recognize some of them in the above photograph of the Washington area. There's the famed Pentagon in the foreground—supported by 41,500 Raymond piles—and the Jefferson Memorial, Department of Commerce Building and General Accounting Office, to mention a few. These buildings in our nation's capital, like hundreds of others in practically every major city in the country, attest to Raymond's years of experience in meeting and solving foundation problems. May we be of service to you?

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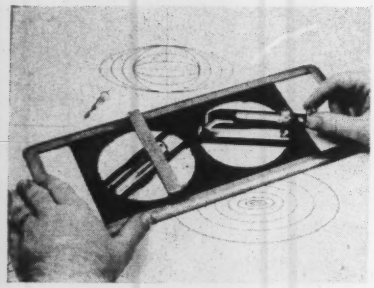
Fowler Ellipsograph

ANYONE, WHETHER A NOVICE OR A SKILLED DRAFTSMAN can draw consistently perfect ellipses of any desired size or degree with the Ellipsograph. This precision instrument enables anyone to transpose orthographic flat plans to pictorial drawings



Precision Instrument

with perspective. Hours of constructional drawings are eliminated as well as a multitude of templates. No mathematical calculations are necessary, since self-calculating charts are provided for every possible ellipse situation, even for isometric ellipses. The Ellipsograph measures $5^{3}/_{4}'' \times 2^{1}/_{2}''$, and is made of fine precision machined steel with important working parts chrome-plated to insure lifetime service. Write **Fowler Engineering, CE 2-114, 1109 Maple Street, Whittier 2, California.**

140 Hp Gasoline Engine

THE NEW 140 HP INTERNATIONAL BLACK DIAMOND 264, a high torque, valve-in-head gasoline engine providing exceptional power output and fuel economy, has been introduced as optional equipment for the five R-160 series truck models. The six-cylinder BD-264 is designed to power trucks in the 14,000 to 17,000 pounds CVW range and highway tractors rated at 29,000 pounds GCW. Important factors in achieving fuel savings are a newly-designed dual-barrel downdraft carburetor and latest-type manifolding. The engine's sustained power exerts definite lessening influence upon such normal operational conditions as downshifting, lugging, fuel-consuming variance in engine speed and driving effort. Also contributing to cold weather performance is a solenoid-operated, overrunning-clutch-type positive engagement starter. The engine also features a new 11 in. clutch providing more than 14% increase in facing area and incorporates such improvements as a fully-ventilated cover and roller-mounted fingers that minimize friction and reduce pedal pressure. Other important elements include controlled-expansion, three-ring aluminum pistons and positive full-pressure lubrication. A high-lift 50° ramp camshaft assures quieter valve operation and eliminates breakage. Engine breathing efficiency is enhanced by a new intake manifold. **International Harvester Co., CE 2-114, 180 N. Michigan Avenue, Chicago 1, Ill.**

Speed Loader

FEATURING AN 180° BOOM SWING, THE Pettibone Speed Loader permits discharge of load to left or right, in addition to front. To accomplish this, the loader does not have to be moved out of the loading position line. With its broad range of accessory attachments, including fork, tote hook, backfiller blade and four cu yd snow bucket, it supplements practically every piece of equipment that a user may have, including that employed for moving railroad cars. Offered in $^{3}/_{4}$ and 1 cu yd bucket models, the Speed Swing is designed with a 30° bucket tilt-up to provide fast

Speed Swing Loader

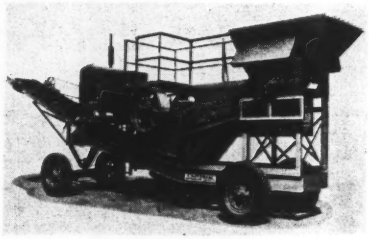
shovel action and permit full loads. Often, loading time can be reduced as much as $^{1}/_{2}$ the usual time. The Speed Swing is available with two or four-wheel drive and optional four wheel steer. Standard features on all models include: torque converter transmission system that delivers uniform power at maximum efficiency and inch-by-inch crowding without shifting gears; a five ft, four in. reach from the front tires at a seven ft dumping height; and a three ft, three in. reach at nine ft, eight in. dumping height; forward-reversing lever; hydraulic steering; four wheel hydraulic booster brakes and full hydraulic control; powerful down pressure on bucket; bucket float control; replaceable bucket lip; large flotation tires on all four wheels; ball bearing turnable; and heavy-duty axles. **Pettibone Mulliken Corp., CE 2-114, 4700 West Division Street, Chicago, Ill.**

For High Density Placement

BY THE INGENIOUS USE OF RUBBER HOSE and a patented gun, the Bondactor, atomizes and deposits a dense concrete with a low water ratio in water-proofing; concrete maintenance; repair; stuccoing; lining reservoirs, etc. The Bondactor is also used for sandblasting. Pre-mixed aggregate is placed in the Bondactor, from which it is continuously metered under air pressure into the material handling hose. When the mixture reaches the nozzle or gun, water and air carried separately by Thermoid's Aquqir hose thoroughly mixes and hydrates the mixture. The first action of the Bondactor is sandblasting which cleans the surface. The sand in the mixture rebounds while the hydrated cement is driven into the surface, building up a base coat of neat cement. Then the concrete layer begins to build up to the thickness required. **Air Placement Equipment Co., CE 2-114, Kansas City, Mo.**

New TS-Traveler

A COMPLETELY RE-DESIGNED VERSION of the original Traveler, the TS-Traveler has been introduced. It consists of a $1^{1}/_{2}$ yd shovel loading hopper with trap grate, reciprocating 19″ plate feeder, 2′ × 4′ inclined gyrating screen, a 1024 roller bearing jaw crusher, 24″ folding channel frame front delivery conveyor, clutch control, and operator's platform and power in a new arrangement on a pneumatic tired gooseneck truck. 1016 and 1020 roller bearing jaw crushers are also available. Compact design, low weight, and high portability permits easy transportation to out of the way locations. The reciprocating plate feeder carries the pit run gravel to



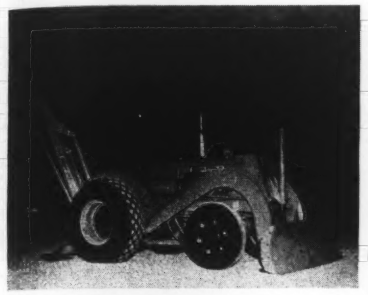
Redesigned Traveler

the screen where natural finish is removed. Oversized is scalped to the jaw crusher, and crushed gravel together with screened material is delivered to trucks or stockpiling conveyors. The TS-Traveler may also be equipped with a two-deck screen and a side delivery conveyor for producing sand. Complete details are available by writing **Universal Engineering Corp., CE 2-114, Cedar Rapids, Iowa.**

EQUIPMENT MATERIALS and METHODS

Hydra-Way

A VERSATILE, SELF-PROPELLED MULTI-PURPOSE MACHINE, the Hydra-Way, is now on the market. A combination of the Hydra-Hammer tower and operating mechanism, the heavy duty, 11 ft deep digging backhoe and a powerful angle bull-

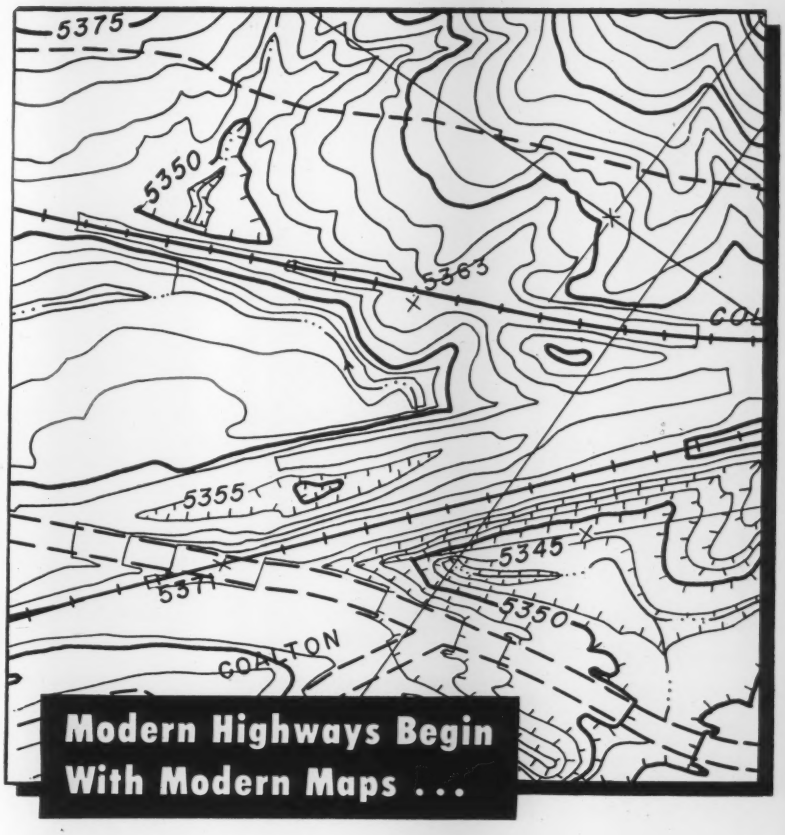


Multi-Purpose Machine

dozer or hydraulic front end loader, this machine can accomplish many jobs such as breaking concrete, cutting asphalt, digging holes and trenches, backfilling, etc. One man operation is possible due to the fact that all digging operations are controlled by only two levers. The rear-mounted Hydra-Hammer tower compacts filled material in an area 135 ft sq, from one standing position; the backhoe, equipped with the "Big-Muscle" feature, is the most powerful in its class; the angle bulldozer comes with optional wing blade extensions to give eight or nine ft width. Extension boom and crane or level loading platform also available, as is rear and front end attachments. Write **Ottawa Steel Inc, CE 2-115, Ottawa, Kansas.**

Electric Accelerometer Head

TYPE AMS-20A ELECTRIC ACCELEROMETER HEAD has been designed for use with carrier-type instrumentation systems. This is available over a wide range of natural frequencies from zero to 1.000 CPS and in acceleration ranges from zero to 500 g's. The moving element is a single metallic ribbon, or filament, under tension and in damping fluid, making possible efficient, accurate damping to any degree. This also insures vibration in only one mode without harmonic resonance. Deflection of the filament under acceleration is measured by inductance-type gages which are connected in a full four arm bridge circuit giving low impedance output, eliminating need for cathode follower accessories. Write for Bulletin '-A-1-A, **Hathaway Instrument Co., CE 2-115, 1315 South Clarkson, Denver, Colorado.**



Modern Highways Begin With Modern Maps . . .

Post-war automobile production has put more vehicles on our highways than they were ever designed to handle. More and new types of highways are vitally needed now. Freeways, turnpikes and toll roads are being planned to shorten the distances, reduce grades and reduce travel time.

Topographic maps produced by Jack Ammann photogrammetric methods— have been produced— or are now being produced for the following:

- **Denver-Boulder Turnpike**
- **West Virginia Turnpike**
- **Kansas Turnpike**
- **Dallas-San Antonio Turnpike**
- **Dallas-Ft. Worth Turnpike**
- **Highway Departments of Vermont, Massachusetts, New York, Connecticut, Rhode Island, New Jersey, Kansas, Texas, California, Washington and Oregon.**

To meet this immediate need, highway officials and consulting engineers have turned to the services of Jack Ammann Photogrammetric Engineers. With Jack Ammann photogrammetry work can be speeded — costs can be cut—just as the highway projects listed have found.

Consult us on your mapping needs. Put our nearly a quarter-of-a-century of mapping experience to work.

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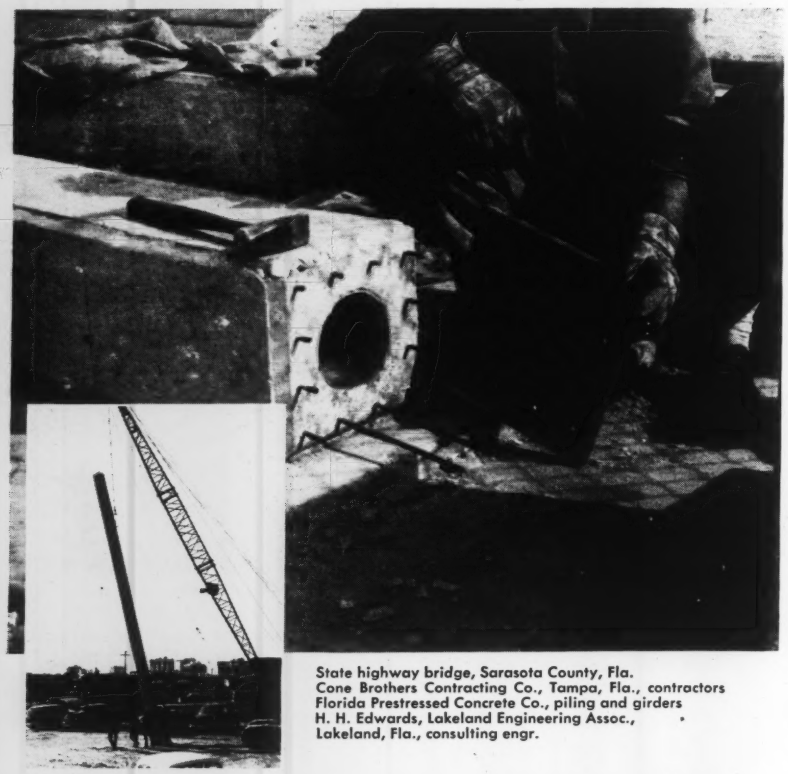
WESTERN OFFICE: (Denver) Lakewood, Colo., 995 Flower St., Phone Bel. 3-2090

FIBRE TUBES

SONOVOID

for voids in concrete construction



State highway bridge, Sarasota County, Fla.
Cone Brothers Contracting Co., Tampa, Fla., contractors
Florida Prestressed Concrete Co., piling and girders
H. H. Edwards, Lakeland Engineering Assoc., Lakeland, Fla., consulting engr.

Lighter weight precast concrete piles!

. . . low cost SONOVOIDS make it possible.

These prestressed precast concrete piles for the Sarasota County, Fla. bridge are lighter in weight and handle easier because SONOVOIDS were used to displace concrete. The bridge was designed by State Roads Dept. of Fla., W. E. Dean, Chief Engineer of Bridges.

The square 12" x 12" piles have hollow cores formed by 6" O.D. SONOVOIDS. Lengths vary from 35 to 42 feet. Each pile contains twelve 5/16 S. R. grade Roebling Cables with a total stress of 126,000 lbs.

For any concrete unit, precast or cast in place, SONOVOIDS save concrete and reinforcing steel without impairment of structural strength. SONOVOID Fibre Tubes are easy to handle and economical to use.

Available in specified lengths up to 50' long or sawed to your requirements on the job. Sizes 2" to 36.9" O.D.

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EQUIPMENT MATERIALS and METHODS

Oil Fired Unit Heater

A NEW 140,000 BTU OIL FIRED, SUSPENDED TYPE unit heater has just been announced. It has been tested and approved by Underwriters Laboratories and its performance checked by 145 installations during the last two years. The heater is a self-contained, factory assembled and wired unit, requiring only a vent, electric outlet and tap to fuel supply. It is equipped with a Century Engineering Co. gun type burner and Minneapolis Honeywell thermostat controls. The fan provides a throw of 50 feet and can be used in the summer for ventilation. The heater uses low cost #2 commercial standard grade fuel oil, and its exceptionally high fuel burning efficiency of 80% reduces costs and eliminates smoke. Designed for permanent heating installations in factories, garages, gas stations, stores and warehouses and for temporary use during construction. Several units may be hooked onto one fuel oil line. **Interstate Heater Manufacturing Co., CE 2-116, 2627 W. Sixth Avenue, Denver, Colo.**

New Wood Laminated Product

A NEW WOOD LAMINATED PRODUCT CALLED DOWELOC, has been introduced. This product is made of various lengths of tongue and grooved edge grain kiln dried hardwood strips fastened or locked together with spiral steel dowels spaced on 12 in. centers. The lumber is made in 12 in. widths and in thicknesses of 1, $1\frac{1}{2}$, and 2 inches, and can be made in any length desired from 6 to 60 ft long. It is "Custom-built" to meet the requirements of each individual job, resulting in savings in installation hours and dollars. It is quickly adaptable to surrounding conditions and then remains unusually stable. Extensive tests prove maximum degree of stability in the wood product is due to the unique design and assembly methods. Doweloc can be used for walls and roof decks as well as floors. Comes in Oak, Hickory, Beech, Birch and Hard Maple. For complete details and test results, write **Edge Grain Timber Products, Inc., CE 2-116, Huntington Bank Building, Columbus 15, Ohio.**

Electric Concrete Vibrator

THE NEW MODEL BU ELECTRIC VIBRATOR has just been placed on the market. This specially designed universal, totally enclosed, high speed ball bearing motor will run at 9,000 vibrations per minute while developing two h.p. The skid mounting protects the motor and allows the unit to be pulled around by the flexible shaft. Also, it has convenient double

(*Continued on page 117*)

handles for lifting. A high-speed, reinforced, $^3/_8$ in. flexible shaft which can be obtained in lengths of 7, 14, or 21 ft. is used. Combinations of these lengths can be attached to each other to give longer lengths up to 35 ft. A $2^1/_2$ in. model 2500 vibrator head with either a steel or rubber tip is furnished. The eccentric weight is mounted in special high speed duplex ball bearings at each end for maximum rigidity and load capacity. For more information, write **The Stow Manufacturing Co., CE 2-116-17, 93 Shear Street Binghamton, N.Y.**

Lightweight Chain Saw

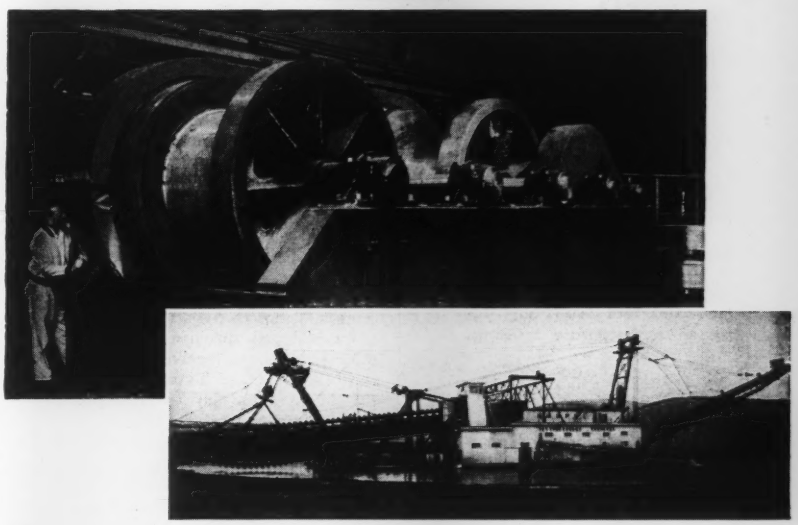
A POWERFUL NEW LIGHTWEIGHT CHAIN SAW, the Model 3MG, designed especially for volume production has been perfected. This model features advanced diaphram carburetion and operates in any position. With a 1 cylinder, 2 cycle, 5 hp economy engine this flawlessly-balanced saw zips through even the toughest timber up to $4^1/_2$ ft in diameter. Full cutting power is maintained while slicing wet or frozen woods. The 3MG has an automatic one-hand rewind type starter; an automatic centrifugal clutch that requires no controls, and an automatic oiler that lubricates the chain sprocket and bar. Its housings, trimmed with durable chrome-plated fittings are die-cast aluminum-magnesium alloy that provides maximum strength with minimum weight. Other features of the 3MG are a dustproof, rainproof ignition system, and a fully automatic clutch. Interchangeable bars 18 to 54 in. long can be used. Price includes engine, bar, chain, chain repair kit and tools. For further information write the **Mall Tool Company, CE 2-117, 7725 S. Chicago Avenue, Chicago 19, Ill.**

Wearpact Alloy Steel

WEARPACT, A NEW TYPE OF ALLOY STEEL with unusually high resistance to impact and abrasion has been announced. This initial hardness combined with high resistance to impact gives Wearpact the ability to withstand abrasion and great impact immediately upon being placed in service. In brief, Wearpact has a tensile strength exceeding 220,000 p.s.i. in the normal range of 470–520 Brinell hardness. Yield point exceeds 180,000 p.s.i., making it highly resistant to flow and distortion. These values are retained at operating temperatures ranging from 450° F. to −50° F. Wearpact can be welded by conventional arc-welding methods; it is machinable, using heavy duty equipment, or it can be finished by grinding. Differential hardness of castings is obtainable,

(*Continued on page 118*)

YUBA-BUILT HOISTS *Lift 1000-Ton Loads*



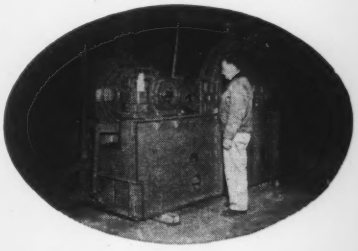
Typifies Machinery We Can Build to Your Order

This YUBA-built double-drum dredge hoist is designed to handle 194-foot digging ladder and is capable of lifting 800 to 1000 tons. Single-drum hoist (bottom) built by YUBA for tramway carries 5200 feet of wire rope. We're old hands at building such machinery. Every bucket ladder dredge Yuba has built combines many special "machines"—hoists, conveyors, drives, screening and metal saving equipment, winches, pumps —all designed and built by Yuba.

Experience and Facilities

YUBA's manufacturing experience includes grooved drums for large gate hoists, barges, steel and chemical plant equipment, construction rigs, clamshell buckets, ordnance, other custom work, and structural steel production. Parts for field assembly are fitted and match-marked before shipment to insure accuracy.

Our facilities include shops for carbon and alloy steel forging, heat treating, steel fabricating, welding, pattern work, iron and bronze castings, and machine shop capable of handling single large, heavy pieces. We have long experience in properly preparing and documenting export shipments.



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EQUIPMENT MATERIALS and METHODS

when a need exists for softer center sections. No difficulties have been encountered in casting Wearpact, and the shrinkage rate is comparable to that of most cast steels. **American Steel Foundries, CE 2-117-18, 410 N. Michigan Avenue, Chicago, 11, Ill.**

New Storage Battery

APPROVAL BY UNDERWRITERS LABORATORIES, INC., OF THE FIRST STORAGE BATTERY designed specifically for emergency lighting has been received. It is believed that the 3-COE-7 Tytex unit is the first plastic-cased battery to be approved by UL. Eight to twelve years of useful life is anticipated for the 3-COE-7. $^1/_4$-inch thick pasted type positive plates and active material of special formulation contribute substantially to this extraordinary long life. Negative plates of heavy, rugged construction are in balance with positive plate characteristics. The active material is locked into both plates by a series of strong horizontal and vertical grid members. This construction assures permanent contact between active material and the grid structure carrying the electrical current. Short circuits, one cause of failure in control circuit batteries, are prevented by triple insulation with inert plastic and rubber, which also assures maximum discharge characteristics due to low resistance. Polystyrene, a clear, heat-resistant plastic, was selected for the container and cover of this battery. State of charge is indicated by colored pilot balls floating in a vertical channel molded into one corner of the container. The battery requires addition of water only once or twice a year under normal circumstances. Available in several capacities and container styles. For additional information write for form 5370, Dept. EL 686, **Exide Industries Div., The Electric Storage Battery Co., CE 2-118 Box 8109, Philadelphia 1, Pa.**

Revised Wheel Design

DESIGN CHANGES HAVE BEEN COMPLETED in the front wheel assembly for the Model D Motor Grader. These revisions have reduced the number of wear points on the leaning front wheel assembly and on the grader's steering mechanism. Shim adjustments are used to take up knuckle wear and brushings have been replaced by tapered and roller bearings. Improved control over the leaning operations have resulted from reducing the travel speed of the leaning front wheels, and adding further strength to the tie rods. As previously, this front wheel lean assembly is optional equipment on the Model D Motor Grader. **Allis-Chalmers Mfg. Co., Tractor Division, CE 2-118, Milwaukee 1, Wisc.**

McCARTHY DRILLS

DRILLS UNDER HIGHWAYS, RAILROADS, ETC.

A utility money-maker! Drills through rock or earth for drainage, conduit, pipe lines, etc., without breaking the surface. Drills 4" to 24" holes up to 180 ft. long in hardpan compacted sand, gravel and shale formations.

McCARTHY VERTICAL AUGER DRILLS

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PROSPECTING

Drills 4-6-8" diameter "dry" holes — 400 to 1,000 ft. per day. Can be mounted on truck or half-track. Hydraulically operated. Adapts to any job where ordinary rock formations need blasting.

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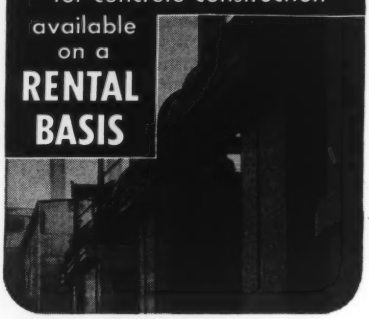

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Literature Available

BITUMINOUS FINISHER—Simplified drawings are employed in a recent catalog on the Bituminous Finisher to illustrate the machine's principles of automatic leveling and thickness control; tamping compaction and control of crown and super-elevation. A detailed, full color cutaway photograph shows the Finisher's inner mechanisms with great clarity. Another page illustrates several accessories which can be fitted to the Finisher, enabling it to perform special functions. **Barber-Greene Company, CE 2-119, 400 No. Highland Ave., Aurora, Ill.**

STAINLESS STEEL PIPING—Data of interest and value to engineers and designers associated with problems involving stainless piping are included in a recently published bulletin. This bulletin outlines methods of bending and joining stainless pipe and discusses the problem of light wall versus heavy wall pipe. Included also in the folder are a table of dimensions and weights of various stainless pipe size schedules and condensed technical data on mechanical and physical properties of the more popular stainless steels used for piping. Bulletin TB 356 is available at the general sales offices of the **Tubular Products Division of The Babcock & Wilcox Company, CE 2-119, Beaver Falls, Pa.**

COLD PRESSURE WELDING—A general information brochure describing the Utica Koldweld process for cold pressure welding has been announced. Utica Koldweld tools, KL-10 for Lapweld and KB-14 for Buttweld, are the only standard tools now available for cold pressure welding of nonferrous metals. They are of "hand-tool" size, employing the "plier-action" principle, and can be operated by unskilled personnel. The Koldweld brochure, which contains many actual photographs, explains in detail the numerous applications of the Utica Koldweld tools already working in the field. One of its chief aims is to aid prospective users in determining applications for Koldweld tools to specific needs of unique interest. The brochure may be obtained from the **Utica Drop Forge & Tool Corp., C. E. 2-119, Utica 4, N.Y.**

REMOTE READING LIQUID LEVEL-GAGE—An eight-page catalog covers in detail the three standard types of Convex Scale and Flat Scale Truscale Remote Reading Gages and shows how these gages bring the liquid level down to where it can easily be seen. This protects valuable equipment and prevents expensive shutdowns. Included in the catalog are features of design and construction; description and schematics showing operation; schematics and charts graphically illustrating the three types of datum columns to meet specific needs; illustrations and descriptions of typical Truscale Gage applications; and information on visible and audible alarms and Truscale Repeaters. Write **Jerguson Gage & Valve Company, C. E. 2-119, 80 Fellsway, Somerville 45, Mass.**

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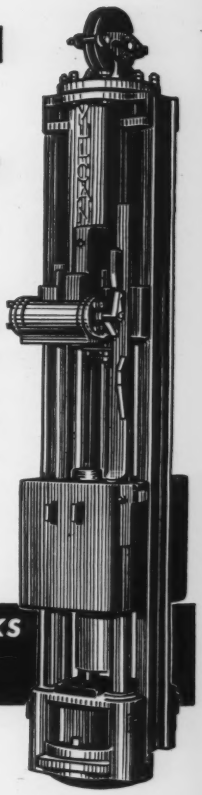
Single-Acting

Steam Pile Hammers Deliver Steady-Heavy Blows



Backed by 68 years of outstanding performance, the Warrington-Vulcan delivers a moderate frequency of low velocity blows from a heavy ram. Operates at medium steam pressure. Built-in durability assures continuous, positive action, free of mechanical difficulties.

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OVER 80 ILLUSTRATIONS

33 YEARS IN THE MAKING

This complete, instructive collection of information about soil sampling in all subsurface conditions, shallow or deep, with hand or power driven tools, is yours for the asking. Modern sampling techniques are discussed with recommendations as to tools and accessories best suited for fast, accurate, economical sampling.

Use the coupon or write for Bulletin 25

REMEMBER, Acker also makes a complete line of Diamond and Shot Core Drills, Drilling accessories and equipment.

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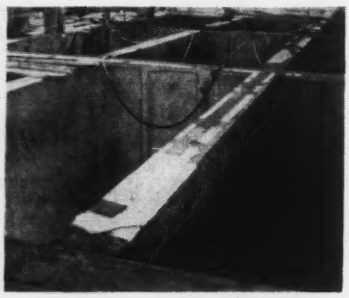

PRECIPITATORS, BREECHINGS, STACKS AND HOPPERS ALL LINED WITH "GUNITE" BY CEMENT GUN CO.

Photos above show units number 1 and 2 of the new 150 m.w. turbo-generator steam electric station of the Pennsylvania Power and Light Company at Sunbury, Pa.

The precipitators, breechings and stacks, visible on the exterior of the building, were all lined with reinforced "Gunite" by Cement Gun Company as were the forty coal hoppers inside the building.

Many instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin B 2400. A request on your letterhead will bring your free copy by return mail.

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Films Available

EXCAVATOR-CRANE—Showing the advantages of the ½ yd excavator-crane mounted on a heavy-duty crawler tractor is a 12 minute color film called "Design for Excavating." Filmed at actual job sites, the picture shows this model in operation on various applications and in several industries. The versatility and convertibility of the machine to a Shovel, Backhoe, Dragline, Clamshell, Crane, Pile Driver and Bulldozer are demonstrated. Caterpillar and Hyster have again produced a machine which will interest those in the earthmoving field. **Hyster Company, CE 2-120, Portland 8, Oregon.**

EXCAVATORS—Excavators in action are featured in two 16 mm color-sound movies which are available from the Marion Power Shovel Company. "The Marion 191-M" tells the story of the world's largest shovel on two crawlers and "Marion and You" depicts the company's entire line. **Advertising Dept., Marion Power Shovel Company, CE 2-120, Marion, Ohio.**

DRAIN AND SEWER PIPE—"Pipe Dream Come True," a film tracing the history of man's fight to control water, is now available from one of the country's manufacturers of bituminized-fibre drain and sewer pipe. The 18 minute documentary film is in full color. It not only shows the history of water control, but it also leads into the specific manufacturing processes and resulting advantages of the company's pipe. **Orangeburg Manufacturing Co., Inc., CE 2-120, Orangeburg, N.Y. and Newark, Calif.**

TRANSITE PIPE—The four types of transite pipe for the home, building sewer pipe, plumbing vent pipe, warm air duct and gas vent, are presented in a new motion picture called "White Pipe." There is an explanation of how this family of asbestos-cement pipes grew from parent products such as transite pressure, sewer and industrial vent pipe. The steps in creating transite pipe are also shown: how selected types of asbestos fiber are blended together and mixed with Portland cement and silica; how the pipe is formed; how it is steam cured to stabilize further its inherent chemical and physical properties; and how each length of pipe is tested before being approved for shipment. The picture then takes up the different pipes in detail, showing typical applications for each type. It covers new developments such as the ring-tite coupling for building sewer pipe, a coupling which is assembled completely without tools. It shows the way in which one length of plumbing vent pipe can do a complete job. It explains the adaptability of transite warm air ducts to perimeter heating systems and demonstrates both oval and round gas vent. The picture, on 16 mm film, is a color-sound film which runs for 35 minutes. "White Pipe" is now available through any of the Johns-Manville sales offices. **Johns-Manville, CE 2-120, 22 East 40th St., New York 16, N.Y.**

The man behind the gun will tell you...

WHITE GIVES YOU

greater, longer-lasting precision...

Shown, model 7014 with "A" standard. Model 7020, same unit with "U" standard, also available.

yet costs less than other quality engineers' transits

LIKE every White quality-built instrument, these engineers' transits give you greater dollar-for-dollar value than any other comparable unit.

For example: White uses a recently-developed Swiss Dividing Engine to cut graduations into solid silver. This insures super-precision from the beginning, safeguards it through more years of hard field usage.

In addition, White engineers' transits give you internal focusing, covered leveling screws and coated optics. These and a host of other design and operating features combine to give you a transit unsurpassed for ease, speed, accuracy, economy and long-lived dependability. Write for Bulletin 1053 and the name of your nearest dealer. DAVID WHITE COMPANY, 359 W. Court Street, Milwaukee 12, Wisconsin.

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From the MANUFACTURERS

Merritt-Chapman & Scott To Acquire Three Companies

Terms of offers Merritt-Chapman & Scott Corporation proposes to make to acquire New York Shipbuilding Corporation, Devoe & Raynolds Company, Inc., and Tennessee Products & Chemical Corporation, three major companies engaged in widely diversified fields, have been outlined in a registration statement filed with the Securities and Exchange Commission in Washington.

Merritt-Chapman & Scott's acquisition plans were announced early in December by Louis E. Wolfson, president and board chairman, after terms of the separate offers M-C&S proposes to make to the shareholders of the three companies for an exchange of shares had been approved by the boards of all four companies involved. Wolfson claimed that it marked the most significant step in the Merritt-Chapman & Scott program for a progressive expansion and diversification of operations.

The registration statement shows that, collectively, the four companies have total gross assets of approximately $200 million, a net worth of approximately $125 million and gross revenues which totalled more than $400 million in 1953.

New York Ship, Devoe & Raynolds and Tennessee Products & Chemical, the companies M-C&S plans to acquire, are active in the fields of shipbuilding, chemicals, paints, automotive equipment, electrical appliances, mining, metallurgy, fuels, building materials and industrial equipment and machinery.

J. N. Robertson Heads the ARBA

John N. Robertson, Director of Highways for the District of Columbia, has been elected as President of the American Road Builders' Association. He succeeds Robert M. Reindollar, engineer consultant of Baltimore.

Mr. Robertson's entire career has been spent with the District of Columbia Department of Highways where he began in April of 1917 as Chainman in one of the department's engineering field parties. In September of 1948, Mr. Robertson was appointed Director of Highways for the District of Columbia. In his capacity as Director, he is on the staff of the Engineer-Commissioner of the District of Columbia. Since his appointment to this top post, he has directed the construction of many projects of vital importance within the District of Columbia. In addition to the projects now underway, Mr. Robertson has recently launched a $125,000,000 program of highway improvements for the District of Columbia which will be undertaken over a period of ten years.

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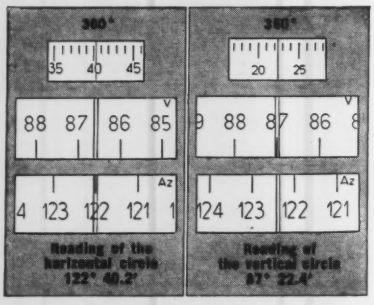

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From the MANUFACTURERS

A. J. Reed Research Director Of Vitrified Clay Pipe Industry

Albert J. Reed, former Senior Research Engineer of the Carborundum Company, has been chosen Director of Research of the National Clay Pipe Research Corporation, it was announced by Clark Sutherland, Corporation President, and D. M. Strickland, President of the National Clay Pipe Association.

This is an organization of the vitrified clay pipe industry wholly engaged in clay pipe research developments, product improvement and study of health-protecting sanitary lines of clay pipe and kindred products.

In 1946, Mr. Reed joined the Carborundum Company as a Development Engineer. He was promoted to Senior Development Engineer in 1948 and became responsible for technical direction of research projects in the field of ceramic bonded abrasives. In 1952, he was made the Senior Research Engineer, Research and Development Division where he worked on research and development on refractory fibers.

To broaden the industry's service to the public, the clay pipe industry has launched an expanded research program aimed at improving existing products and developing new clay products.

LeTourneau-Westinghouse To Buy The Adams Company

Edward O. Boshell, Chairman and President of Westinghouse Air Brake Company, announced that a general agreement has been reached covering the purchase of the plant and assets of the J. D. Adams Manufacturing Company of Indianapolis by LeTourneau-Westinghouse Company of Peoria, Illinois.

The acquisition of the Adams Company adds a complete line of road maintenance motor-graders to the products now distributed by the Peoria firm, which makes a full line of earth-moving equipment, including scrapers, bulldozers, and hauling units. The company, which was the first to equip earth-moving scrapers with pneumatic tires, is a leading U. S. manufacturer of this equipment which is used throughout the world.

Mr. Boshell said that the manufacturing operations will remain in Indianapolis where they are planning to build additional products.

The agreement is subject to approval by Adams shareholders and necessary corporate action, as well as the adjustment of several legal and technical matters. As part of its diversification program, Westinghouse Air Brake last year bought the earth-moving equipment business of R. G. LeTourneau Inc. and organized the LeTourneau-Westinghouse Company.

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The American Society of Civil Engineers announces the availability of a new supply of "The Engineer's Creed," which originally appeared in the November, 1948 issue of CIVIL ENGINEERING. This new de luxe reprint, 8½ x 11", has been produced on lightweight parchment, and is suitable for framing.

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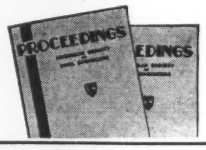

PROCEEDINGS AVAILABLE

The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical Division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 125) to Society Headquarters. For ordering separate papers, use the convenient order form on page 124.

December

582. Index to Proceedings, Volumes 76 to 80 (1950–1954), by the Board of Direction, Committee on Publications. A subject and author index has been prepared for all Proceedings-Separates since No. 1. The indexes for the five annual volumes are compiled separately so that one can detach them and assemble each index with the appropriate volume. The subject headings that were used were taken from the names of the technical divisions; other headings were added when deemed necessary. By use of this index it is possible to trace the discussion that a paper has received, a feature that has long been sought by technical readers.

January

583. Ultimate Slopes and Deflections—A Brief for Limit Design, by George C. Ernst. (ST) The familiar concepts of slope and deflection are presented as a means of analyzing continuous beams and rigid frames for the evolution of plastic hinges and subsequent failure under static loadings. The presentation is an argument in behalf of limit design in that the necessary relationship between load and deflection is demonstrated.

584. Lightweight Aggregates for Structural Concrete, by Adrian Pauw. (ST) The paper describes the nature and use of commercially produced aggregates suitable for lightweight concrete of structural quality. Properties of typical lightweight aggregates and the physical properties of lightweight structural concrete and their effect on design are described. An attempt is made to evaluate the conditions under which the use of these materials is economical.

585. Probabilities of Traffic Loads on Bridges, by Sven Olof Asplund. (ST) The paper considers, for any determinate load length, what design intensity of lane load can be logically inferred from the largest design vehicle and from the average long lane load. Design loads are determined so that the probabilities for exceeding them are made extremely small but not zero.

586. Multiple Span Gabled Frames, by John D. Griffiths. (ST) Single-span rigid frames have gained great popularity whereas little use is made of multiple-span frames. This restricted use is due, in no small measure, to the complexity of analysis for multiple spans. Less laborious design procedures for gabled rigid frames of multiple span are presented.

587. Wind Loads on Girder Bridges, by John M. Biggs, Saul Namyet, and Jiro Adachi. (ST) The paper presents the results of wind-tunnel tests on nine different types of railroad and highway bridges. Drag coefficients for horizontal and vertical forces and overturning moments are given for all probable wind directions. The results are compared with current design specifications.

588. Continuous Prestressing, by Robert B. B. Moorman. (ST) The nature and treatment of prestress loads for continuous prestressed concrete beams are described. Two examples are worked out, and an approximate method of determining friction losses is discussed. The writer also presents a procedure for analysis and design.

589. Discussion of Proceedings-Separates 451, 469, 544. (ST)

590. Fundamental Concepts of Rectangular Settling Tanks, by Alfred C. Ingersoll, Jack E. McKee, and Norman H. Brooks. (SA) Investigation of fundamental theories of sedimentation, scour by turbulent eddies, inlet and outlet disturbances, and sludge thickening phenomena indicates that settling tanks should be designed on the basis of surface area and that rectangular tanks should be long and narrow. To replace the highly inadequate, conventional measure of efficiency of settling tanks, a new rational measure—the overflow residual efficiency—has been developed theoretically.

591. Design of Treatment Plants for Low Turbidity Water, by Roy H. Ritter. (SA) Design features and graphical analyses of actual operating records are presented for four plants where low turbidity waters are effectively treated. The relationships of alum dosage to raw water characteristics of turbidity and color and to design criteria of detention and overflow rates are analyzed. A concept of threshold turbidity, below which alum dosage is not closely related to turbidity, is suggested.

592. Sand Filtration Studied with Radiotracers, by Donald R. Stanley. (SA) The approach to the design of mechanisms involved in the removal of suspended particles from water by rapid sand filters has been largely empirical. The development of methods and equipment for using radioactive tracers has greatly aided the present study. The writer investigated the more important variables involved in the operation of rapid sand filters; he presents formulas for expressing these variables and methods of investigating others.

INSTRUCTIONS

1. Every ASCE member registered in one of the Technical Divisions will receive free and automatically all papers sponsored by that Division. **Such registration will be effective the first of the month following the receipt of the registration form.**

2. In addition to those papers sponsored by the Division in which he is registered, a member is entitled to 100 different papers during a fiscal year.

3. Members' accounts will be charged 25¢ each for additional duplicate copies of a paper and for papers in excess of his free allotment.

4. Papers should be ordered by serial number. The member should keep a record of Separates ordered to avoid unwanted duplication.

5. Non-members of the Society may order copies of Proceedings papers by letter with remittance of 50¢ per copy; members of Student Chapters, 25¢ per copy.

Standing orders for all Separates in any calendar year may be entered at the following annual rates: Members of ASCE, $12.00; members of Student Chapters, $12.00; non-members, $20.00, plus foreign postage charge of $0.75; libraries, $10.00.

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593. Ground Water in the Delaware River Valley, by H. C. Barksdale and S. M. Lang. (SA) Within the Delaware River valley are present two major geologic subdivisions. The Fall Line, which extends in a southwesterly direction, separates an area of unconsolidated material to the southeast containing productive water-bearing formations from an area of consolidated rocks to the northwest in which the aquifers are not suitable for the development of large groundwater supplies.

594. Advances in Sewage Treatment in the Period from September 1, 1952 to October 1, 1954: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment. (SA) For the first time in ten years the country became more or less free of wartime restrictions. Easing of the municipal bond market helped stimulate construction. The outstanding development was the attack on the high cost of sludge disposal by improvements in the concentration, digestion, and vacuum filtration of sludge. Industry was active in developing methods for treating its industrial wastes.

595. Discussion of Proceedings-Separates 302, 307, 399, 419, 471. (SA)

596. Determining the Required Thickness of Concrete Pavements for Highways, by Joseph Herbert Moore. (HW) The paper presents data which indicate that the longitudinal edge loading position is actually the critical loading position when the restrained warping stresses and lateral distribution of vehicles across the traffic lanes are rightly considered. A table of "load percent factors" is given to simplify and make applicable the recommended design method. The method indicates that pavements 8 or 9 in. thick give longest life.

597. Sight Distances at Undercrossings, by Paul Hartman. (HW) Daylight sight distances on highway sag vertical curves may be limited by a structure crossing the right-of-way. Conventional formulas for determining this sight distance are derived for the case in which the critical edge of the structure is directly above the vertex of the vertical curve. Despite this limitation, the formulas are considered to be applicable. Formulas are derived which are correct for any position of the structure.

598. Discussion of Proceedings-Separates 276, 320, 351, 357, 500. (HW)

599. Private Enterprise Can Meet the Parking Demand, by C. T. McGavin. (CP) The parking problem in cities in the United States is re-evaluated in terms of the ability of private enterprise to continue its present expansion rate in order to meet the increased demand for parking facilities. The history of the parking industry and its accomplishments are traced. The basic principles of constitutional law, political philosophy, and taxation are discussed as they affect parking.

600. Denver's Master Street Plan, by John S. Marshall. (CP) The city, the state, and the Bureau of Public Roads in 1949 designed a master street plan which would meet traffic needs over the next twenty years. An efficient and adequate layout of major streets is a primary element of the plan. Mass transportation received serious consideration as an integral part of the traffic problem. The plan covers 14% of all Denver's street mileage.

601. Pittsburgh's Comprehensive Improvement Program, by Park H. Martin. (CP) The importance of an urban-area-wide approach to the solution of problems in the Pittsburgh metropolitan area is emphasized. Programs for smoke abatement, flood control, stream pollution abatement, urban redevelopment, and parking are described. Mass transportation, recreational and educational facilities, and the financial background of the improvements are briefly treated.

602. Organization for Metropolitan Traffic and Transportation Planning, by Charles A. Blessing. (CP) The paper reviews the broad problems of metropolitan transportation planning. There is outlined an organizational pattern for coordinating the activities of the traffic engineer, highway engineer, transportation expert, railroad-transportation expert, city planner, and public finance expert in the development of a comprehensive metropolitan transportation system.

603. Integration of Local Streets with the Atlanta Expressway System, by Karl A. Bevins. (CP) The cooperation of public agencies and business groups to solve Atlanta's highway problems is described. Because proposed expressways cannot meet arterial traffic demands, they must be supplemented by the improvement of surface radials. Expected traffic volumes and street capacities are compared across a "screen line" formed by an existing railroad belt line.

604. A New Approach to Turbulent Boundary Layer Problems, by Donald Ross. (EM) From physical considerations involving the diffusion of turbulent stresses, the boundary layer is divided into three regions distinguished by the relative proximity of the wall. This new physical analysis, combined with empirical correlations, leads to a method for calculating two-dimensional turbulent boundary layers which is more versatile than any of the previously published methods.

605. Impact on Pinjointed Trusses, by Bruno A. Boley and Chi-Chang Chao. (EM) A method for the analysis of pinjointed trusses of arbitrary configuration subjected to impact at some of their joints is presented. Expressions are derived describing the behavior of the various types of joints present in a truss; with the aid of these, a numerical calculation procedure is developed. The method can be used whether impact is caused by a known pressure pulse or by collision with a solid object. It is equally applicable to both three-dimensional and plane trusses.

606. Discussion of Proceedings-Separates 281, 296, 300, 330, 333, 375, 387, 396. (EM)

607. Lateral Buckling of Eccentrically Loaded I-Columns, by Mario G. Salvadori. (EM) The critical combination of thrust and unequal end-moments or eccentricities for the lateral buckling of columns elastically restrained against rotation about the principal axes at the end section and prevented from twisting about the column axis at the end section are described for various values of the Timoshenko parameter L^2/a^2 and of the end-moments ratio. It is shown that these critical combinations are easily obtainable as soon as the critical value of equal end-moments without thrust is known for columns free to rotate at their ends (simply supported columns).

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